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ABSTRACT

This document is intended to help education and training institutions deliver the Machine Tool Advanced Skills Technology (MAST) curriculum to a variety of individuals and organizations. MAST consists of industry-specific skill standards and model curricula for 15 occupational specialty areas within the U.S. machine tool and metals-related industries. This volume provides the MAST standards and curriculum for the manufacturing engineering technician specialty area. (A manufacturing engineering technician is a person who uses special knowledge and skills to recommend and implement solutions for specific manufacturing applications.) This volume is organized in the following sections: (1) a profile of Texas State Technical College, the development center that produced these standards and curriculum; (2) a manufacturing engineering technician competency profile of job duties and tasks; (3) a manufacturing engineering technician duty, task, and subtask outline; (4) a course curriculum outline and course descriptions; (5) a technical workplace competencies and course crosswalk; and (6) a Secretary's Commission on Achieving Necessary Skills (SCANS) proficiencies crosswalk. Individual syllabi for the following courses are provided: Machine Tool Practices I; Drafting Principles; Machine Tool Practices II; Application Software; Engineering Materials; Safety and Accident Prevention; Basic Fluid Power; Electrical Applications; Survey of Welding Processes and Applications; Computer Numerical Control (CNC) Machine Programming; Statics; Manufacturing Processes; Introduction to Computer Drafting; Computer-Assisted Design/Manufacturing (CAD/CAM) I; Tool Design I; Strength of Materials; CAD/CAM II; Computer Integrated Manufacturing; Quality Assurance and Statistical Process Control; and Engineering Technology Project. Each course syllabus includes the following: course hours, course descriptions, prerequisites, required course materials, teaching and evaluation methods, lecture and laboratory outlines, course objectives for technical and SCANS competencies, and suggested references. An appendix contains industry competency profiles. (KC)

ED 401 434

Machine Tool Advanced Skills Technology

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COMMON GROUND: TOWARD A STANDARDS-BASED TRAINING SYSTEM FOR THE U.S. MACHINE TOOL AND METAL RELATED INDUSTRIES

VOLUME 4

MANUFACTURING ENGINEERING TECHNOLOGY

of
a 15 volume set of Skills Standards
and
Curriculum Training Materials for the
PRECISION MANUFACTURING INDUSTRY

Supported by
the Office of Vocational & Adult Education
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AUGUSTA TECHNICAL INSTITUTE

CACT CENTER FOR APPLIED COMPETITIVE TECHNOLOGIES
San Diego City College

ITAWAMBA COMMUNITY COLLEGE · 1948 ·

Moraine Valley Community College

SPRINGFIELD TECHNICAL COMMUNITY COLLEGE

Texas State Technical College Waco

Machine Tool Advanced Skills Technology Program

MAST

VOLUME 4

MANUFACTURING ENGINEERING TECHNOLOGY

Supported by
The Office of Vocational and Adult Education
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September, 1996

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- U.S. Department of Education, Office of Vocational & Adult Education
- MAST Consortia of Employers and Educators

MAST DEVELOPMENT CENTERS

Augusta Technical Institute - Itawamba Community College - Moraine Valley Community College - San Diego City College (CACT) - Springfield Technical Community College - Texas State Technical College

INDUSTRIES

AB Lasers - AIRCAP/MTD - ALCOA - American Saw - AMOCO Performance Products - Automatic Switch Company - Bell Helicopter - Bowen Tool - Brunner - Chrysler Corp. - Chrysler Technologies - Conveyor Plus - Darr Caterpillar - Davis Technologies - Delta International - Devon - D. J. Plastics - Eaton Leonard - EBTEC - Electro-Motive - Emergency One - Eureka - Foster Mold - GeoDiamond/Smith International - Greenfield Industries - Hunter Douglas - Industrial Laser - ITT Engineered Valve - Kaiser Aluminum - Krueger International. - Laser Fare - Laser Services - Lockheed Martin - McDonnell Douglas - Mercury Tool - NASSCO - NutraSweet - Rapistan DEMAG - Reed Tool - ROHR, International - Searle - Solar Turbine - Southwest Fabricators - Smith & Wesson - Standard Refrigeration - Super Sagless - Taylor Guitars - Tecumseh - Teledyne Ryan - Thermal Ceramics - Thomas Lighting - FMC, United Defense - United Technologies Hamilton Standard

COLLEGE AFFILIATES

Aiken Technical College - Bevil Center for Advanced Manufacturing Technology - Central Florida Community College - Chicago Manufacturing Technology Extension Center - Great Lakes Manufacturing Technology Center - Indiana Vocational Technical College - Milwaukee Area Technical College - Okaloosa-Walton Community College - Piedmont Technical College - Pueblo Community College - Salt Lake Community College - Spokane Community College - Texas State Technical Colleges at Harlington, Marshall, Sweetwater

FEDERAL LABS

Jet Propulsion Lab - Lawrence Livermore National Laboratory - L.B.J. Space Center (NASA) - Los Alamos Laboratory - Oak Ridge National Laboratory - Sandia National Laboratory - Several National Institute of Standards and Technology Centers (NIST) - Tank Automotive Research and Development Center (TARDEC) - Wright Laboratories

SECONDARY SCHOOLS

Aiken Career Center - Chicopee Comprehensive High School - Community High School (Moraine, IL) - Connally ISD - Consolidated High School - Evans High - Greenwood Vocational School - Hoover Sr. High - Killeen ISD - LaVega ISD - Lincoln Sr. High - Marlin ISD - Midway ISD - Moraine Area Career Center - Morse Sr. High - Point Lamar Sr. High - Pontotoc Ridge Area Vocational Center - Putnam Vocational High School - San Diego Sr. High - Tupelo-Lee Vocational Center - Waco ISD - Westfield Vocational High School

ASSOCIATIONS

American Vocational Association (AVA) - Center for Occupational Research and Development (CORD) - CIM in Higher Education (CIMHE) - Heart of Texas Tech-Prep - Midwest (Michigan) Manufacturing Technology Center (MMTC) - National Coalition For Advanced Manufacturing (NACFAM) - National Coalition of Advanced Technology Centers (NCATC) - National Skills Standards Pilot Programs - National Tooling and Machining Association (NTMA) - New York Manufacturing Extension Partnership (NYMEP) - Precision Metalforming Association (PMA) - Society of Manufacturing Engineers (SME) - Southeast Manufacturing Technology Center (SMTC)

MAST PROJECT EVALUATORS

Dr. James Hales, East Tennessee State University and William Ruxton, National Tooling and Machine Association (NTMA)

SPECIAL RECOGNITION

Dr. Hugh Rogers recognized the need for this project, developed the baseline concepts and methodology, and pulled together industrial and academic partners from across the nation into a solid consortium. Special thanks and singular congratulations go to Dr. Rogers for his extraordinary efforts in this endeavor.

This report is primarily based upon information provided by the above companies, schools and labs. We sincerely thank key personnel within these organizations for their commitment and dedication to this project. Including the national survey, more than 3,000 other companies and organizations participated in this project. We commend their efforts in our combined attempt to reach some common ground in precision manufacturing skills standards and curriculum development.

This material may be found on the Internet at **http://machinetool.tstc.edu**

CATALOG OF 15 VOLUMES

VOLUME 1	EXECUTIVE SUMMARY STATEMENT OF THE PROBLEM MACHINE TOOL ADVANCED SKILLS TECHNOLOGY PROJECT PROJECT GOALS AND DELIVERABLES PROJECT METHODOLOGY PROJECT CONCLUSIONS AND RECOMMENDATIONS APPENDICES
VOLUME 2	CAREER DEVELOPMENT GENERAL EDUCATION REMEDIATION
VOLUME 3	MACHINING - CORE COURSES (MAC)
VOLUME 4	MANUFACTURING ENGINEERING TECHNOLOGY (MET)
VOLUME 5	MOLD MAKING (MLD)
VOLUME 6	WELDING (WLD)
VOLUME 7	INDUSTRIAL MAINTENANCE (IMM)
VOLUME 8	SHEET METAL (SML) AND COMPOSITES (COM)
VOLUME 9	TOOL AND DIE (TLD)
VOLUME 10	COMPUTER-AIDED DRAFTING AND DESIGN (CAD)
VOLUME 11	COMPUTER-AIDED MANUFACTURING AND ADVANCED CNC (CNC)
VOLUME 12	INSTRUMENTATION (INT)
VOLUME 13	LASER MACHINING (LSR)
VOLUME 14	AUTOMATED EQUIPMENT TECHNOLOGY (CIM)
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VOLUME 4
MANUFACTURING ENGINEERING TECHNOLOGY

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FOREWORD

After numerous interviews with practitioners from industry (see Appendix A), and discussions with numerous educators, managers, supervisors, and others involved with machine related occupations and specifically machining, the **MAST** Consortium Partners have agreed to present our definition of a Manufacturing Engineering Technician as follows:

MANUFACTURING ENGINEERING TECHNICIAN - ***one who uses special knowledge and skills to recommend and/or implement solutions for specific manufacturing applications.***

MAST has also determined that individuals working as Manufacturing Engineering Technicians will preferably have received at least two years of training and education in both academic and technical courses in the areas of manufacturing methods and processes. This training may have been conducted in a vocational institution or college. Our research indicates that a minimum of two years of vocational training will prepare students with entry level skills necessary to begin work as a Manufacturing Engineering Technician.

In this program, the students progress through a series of courses designed to both educate and train students with skills and knowledge in areas such as manufacturing materials and methods, conventional and CNC machining, computer-aided drafting and design, engineering mechanics and design, computer-aided manufacturing, and robotics. Students receive a wide range of training which enables them to seek jobs in many different manufacturing areas. The Manufacturing Engineering Technology Program at Texas State Technical College has been training Manufacturing Engineering Technicians for many years and works closely with advisory committee members to make sure that the skills being taught are the skills needed in industry. Students who graduate from this course of study receive Associate of Applied Science degrees from TSTC. The MET Department worked closely with the MAST staff, made every effort to assist the MAST staff with research and seek adoption of the recommended MAST materials for their MET students. The MET Department at TSTC is recognized throughout Texas by large and small manufacturing companies as a premier source for entry-level technicians. Upon graduation, students are able to interpret complex drawings, select the correct materials and perform all necessary machining processes. The curriculum has been designed to prepare students to enter the workforce as entry level Manufacturing Engineering Technicians. Laboratory work is emphasized with actual industrial equipment in order to prepare students for interesting, rewarding work in a wide variety of industries. The MET department has a unique blend of theoretical knowledge and practical application which directly corresponds to modern uses in manufacturing. Students may choose from three options of study: Computer-Aided Manufacturing, Machining and Plastics. This volume contains the justification, documentation and course syllabi for the courses which we recommend as minimum training for individuals desiring to become Manufacturing Engineering Technicians.

PARTNER OCCUPATIONAL SPECIALITY ASSIGNMENTS

Although each of the six partner college development centers possessed detailed expertise in each of the MAST 15 occupational specialities, a division of work was still very necessary to ensure completion of the project due to the enormity associated with industrial assessment and complete curriculum revision for each of the areas of investigation.

Each Collegiate Partner was responsible for development of a specialization component of the overall model. Information for the future direction of this specialization area was obtained from NIST Manufacturing Centers and/or national consortia, professional societies, and industrial support groups addressing national manufacturing needs. Each Collegiate Partner tested its specialization model utilizing local campus resources and local industry. Information gained from the local experience was utilized to make model corrections. After testing and modification, components were consolidated into a national model. These events occurred during the first year of the Program. During the second year of the Program, the national model was piloted at each of the Collegiate Partner institutions. Experience gained from the individual pilot programs was consolidated into the final national model.

What follows is a profile of the MAST development center which had primary responsibility for the compilation and preparation of the materials for this occupational specialty area. This college also had the responsibility for conducting the pilot program which was used as one of the means of validation for this program.

MAST DEVELOPMENT CENTER
Texas State Technical College
Center for Contemporary Technology

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Manufacturing in Texas

Economic trends have led Texas officials to recognize the need to better prepare workers for a changing labor market. The downturn in the oil, natural gas, ranching and farming industries during the last decade diminished the supply of high-paying, low-skill jobs. Growth in Texas is occurring in the low paying, low skills service industry and in the high skills, high paying precision manufacturing industry. In Texas, projected increases by the year 2000 include 4,050 jobs for machine mechanics (24% growth rate); 4,700 jobs for machinists (18% growth rate); 3,850 numeric control operators (20% growth rate); and 107,150 general maintenance repair technicians (23% growth rate). The National Center for Manufacturing Sciences (NCMS) identified that of the top twenty manufacturing states, Texas experienced the largest increase in manufacturing employment. Manufacturing will add over 70,000 additional jobs in Texas by the year 2000 with increases in both durable and non-durable goods.

Texas State Technical College (TSTC)

Texas State Technical College System (TSTC) is authorized to serve the State of Texas through excellence in instruction, public service, research, and economic development. The system's efforts to improve the competitiveness of Texas business and industry include centers of excellence in technical program clusters on the system's campuses and support of educational research commercialization initiatives. Through close collaboration with business, industry, governmental agencies, and communities, including public and private secondary and postsecondary educational institutions, the system provides an articulated and responsive technical education system.

In developing and offering highly specialized technical programs and related courses, the TSTC system emphasizes the industrial and technological manpower needs of the state. Texas State Technical College is known for its advanced or emerging technical programs not commonly offered by community colleges.

New, high performance manufacturing firms in areas such as plastics, semiconductors and aerospace have driven dynamic change in TSTC's curriculum. Conventional metal fabrication to support oil and heavy manufacturing remains a cornerstone of the Waco campus and is a primary reason TSTC took the lead in developing new curricula for machining and manufacturing engineering technology in the MAST program.

Development Team

- **Project Director**: Joe K. Penick, Grant Director for Machine Tool Advanced Skills Technology Program (MAST); served as the primary administrator and academic coordinator for the MAST project.
- **Subject Matter Expert**: Wallace Pelton, Site Coordinator, was responsible for developing skill standards and course/program materials for the conventional machining, mold making and manufacturing engineering technology components of the MAST project.

THE MAST COMPETENCY PROFILE

Development of Competency Profiles at each of the MAST sites began with visits to representative companies for the purpose of surveying expert workers within the industry and occupational areas under investigation. Each site began the survey process by asking a subject matter expert in the targeted technical area, generally a member of their faculty, to employ a modified version of the generally-accepted DACUM (Developing A Curriculum) method to categorize the major skills needed to work in the selected occupation. As source materials, the college instructors drew on their professional knowledge and experience of current and future industry requirements. The initial skill standards developed by the subject matter experts underwent numerous internal reviews and revisions within each site, assuming final form as a series of structured survey and interview statements designed to elicit a simple yes or no response.

To determine an appropriate survey sample, each site compiled a database of their region's small and medium-sized manufacturers and searched for companies likely to employ workers in the targeted occupational area. The resulting cross-industry samples were sorted further to achieve a balance of technological capability and workforce size; the sample companies within each region were then asked to participate in the project. Willing respondents were scheduled for interviews.

During the company interviews, MAST staff asked expert workers to identify the primary duties and tasks performed by a typical worker and to consider the special skills and knowledge, traits and attitudes, and industry trends that will have an impact on worker training, employability, and performance both now and in the future. The interview results were analyzed to create individual profiles identifying the most common duties and skills required of workers at each company. Copies of individual company competency profiles are provided in Appendix A of this volume. These individual company Competency Profiles served two purposes. First, they showed, in a format that could be easily understood by both industry and educators, a picture of the occupational specialty at a given company at that particular time. Second, these individual company Competency Profiles furnished the company with a document for which they could claim ownership. This, in effect, made them "real" partners in the work of MAST.

Data for all companies were then aggregated to develop a composite Competency Profile of industry skill standards within the selected occupational specialty area of, as shown in the following pages.

These same duties and tasks were then included in both the Texas and National Surveys for further validation (see Volume 1). As a result of the surveys, additional refinements were made to the Competency Profiles. These changes were then incorporated into the individual course syllabi which were used for the pilot program.

The MAST Competency Profile for this occupational specialty area has been included on the following pages.

SKILLS AND KNOWLEDGE

Communication Skills
Use Measurement Tools
Use Inspection Devices
Mathematical Skills
Reading/Writing Skills
Knowledge of Safety Regulations
Practice Safety in the Workplace
Organizational Skills
Knowledge of Company Policies/Procedures
Mechanical Aptitude
Ability to Comprehend Written/Verbal Instructions
Basic Knowledge of Fasteners
Ability to Work as Part of a Team
Converse in the Technical Language of the Trade
Knowledge of Occupational Opportunities
Knowledge of Employee/Employer Responsibilities
Knowledge of Company Quality Assurance Activities
Practice Quality-Consciousness in Performance of the Job

TEXAS STATE TECHNICAL COLLEGE WACO
MAST PROGRAM REPRESENTATIVES

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Director

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TERRY SAWMA
Research Coordinator

WALLACE PELTON
Site Coordinator

ROSE MARY TIMMONS
Senior Secretary/Statistician

Furnished By:

Texas State Technical College Waco

TRAITS AND ATTITUDES

Strong Work Ethic
Interpersonal Skills
Punctuality
Dependability
Honesty
Neatness
Safety Conscientious
Motivation
Responsible
Physical Ability
Professional
Trustworthy
Customer Relations
Personal Ethics

TOOLS AND EQUIPMENT

Machinist's Tools (e.g., calipers, dial indicators magnetic tool holders, etc.)
Measuring Tools
Power Tools
Metal Lathe with Attachments
Drill Presses
Vertical Mill with Attachments
Power Saws
Power Drills
Hydraulic/Arbor Press
Heat Treatment Equipment
Hardness Testing Equipment
Grinding Machines with Attachments
Welding Equipment (SMAW, GMAW, FCAW, Plasma)
CNC Machining Center and Turning Center
Gear Producing Machines with Attachments
Jig Boring Machines
Alignment/Calibration Tools
Coolant Recovery Equipment
Computer
Ventilation Equipment
Forklift
Personal Safety Equipment
Oxyacetylene Equipment
Tool Storage Equipment
Workbenches
Vises
Pedestal Grinders
Weld Test Equipment
Optical Comparator
Coordinate Measurement Machine
Hydraulic/Pneumatic Training Equipment
Electrical Training Equipment
Safety Training Equipment

FUTURE TRENDS AND CONCERNS

Statistical Process Control
Composites
Laser Machining
Advanced Computer Applications
Robotics
Environmental Concerns
Fiber Optic Controls
Automated Material Handling Equipment
Computer Integrated Manufacturing

COMPETENCY PROFILE

Manufacturing Engineering Technician

Prepared By
M.A.S.T.
Machine Tool Advanced Skills
Technology Program
and
Consortium Partners
(V.199J40008)

***M*achine Tool *A*dvanced *S*kills**
***T*echnology Program**

MAST

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MANUFACTURING ENGINEERING TECHNICIAN .... use special knowledge and skills to recommend and/or implement solutions for specific manufacturing applications.

Duties	Tasks												
A Practice Safety	A-1 Follow safety manuals and all safety regulations/ requirements	A-2 Use protective equipment	A-3 Follow safe operating procedures for hand and machine tools	A-4 Maintain a clean and safe work environment	A-5 Control fire hazards	A-6 Apply American Red Cross First Aid and CPR procedures	A-7 Recommend hazardous waste management techniques	A-8 Apply ergonomic principles to the workplace	A-9 Demonstrate knowledge of state and federal EPA regulations				
B Apply Mathematical Concepts	B-1 Perform basic arithmetic functions	B-2 Interconvert fractions/ decimals	B-3 Interconvert Metric/ English measurements	B-4 Perform basic algebraic operations	B-5 Perform basic trigonometric functions	B-6 Calculate speeds and feeds for machining	B-7 Locate machining points from a datum point	B-8 Perform calculations for sine bar and sine plate	B-9 Calculate for direct, simple, and angular indexing	B-10 Perform calculations necessary for turning tapers	B-11 Solve for little "h"	B-12 Use all functions on a scientific calculator	B-13 Solve engineering equations
	B-14 Solve static systems for resultant force	B-15 Determine strength of materials for various applications											
C Interpret Engineering Drawings and Control Documents	C-1 Review blueprint notes and dimensions	C-2 Identify basic layout of drawings	C-3 Identify basic types of drawings	C-4 List the purpose of each type of drawing	C-5 Verify drawing elements	C-6 Practice Geometric Dimensioning and Tolerancing (GD&T) methodology	C-7 Describe the relationship of engineering drawings to planning	C-8 Use standards to verify requirements	C-9 Analyze bill of materials (BOM)	C-10 Understand and use quality systems			
D Recognize Different Manufacturing Materials and Processes	D-1 Identify materials with desired properties	D-2 Identify materials and processes to produce a product	D-3 Describe heat treating processes	D-4 Perform heat treating operations	D-5 Test metal samples for hardness	D-6 Describe casting processes	D-7 Describe hot working processes	D-8 Describe cold working processes	D-9 Evaluate alternative manufacturing processes				
E Demonstrate Measurement/ Inspection Techniques	E-1 Identify types of measurement used in manufacturing	E-2 Select proper measurement tools	E-3 Apply proper measuring techniques	E-4 Use Metric and English standards of measurement	E-5 Perform measurements with hand held instruments	E-6 Perform measurements on surface plate	E-7 Perform inspections using stationary equipment						
F Perform Conventional Machining Operations	F-1 Prepare and plan for machining operations	F-2 Use proper hand tools	F-3 Operate power saws	F-4 Operate drill presses	F-5 Operate vertical milling machines	F-6 Operate horizontal milling machines	F-7 Operate metal cutting lathes	F-8 Operate grinding/ abrasive machines					
G Perform Advanced Machining Processes	G-1 Prepare and plan for CNC machining operations	G-2 Select and use CNC tooling systems	G-3 Program CNC machines	G-4 Operate CNC machining centers (mills)	G-5 Operate CNC turning centers (lathes)	G-6 Operate electrical discharge machines	G-7 Download programs via network	G-8 Program CNC Machines using CAM System					
H Perform Gear Generating Operations	H-1 Describe the different types of gears	H-2 Understand gear terms	H-3 Use rotary tables and dividing heads	H-4 Discuss gear inspection and measurement									
I Perform Welding Operations	I-1 Weld with Shielded Metal Arc Welding (SMAW) process	I-2 Weld/cut with oxyacetylene	I-3 Weld with Gas Tungsten Arc Welding (GTAW) (Heliarc)	I-4 Weld with Gas Metal Arc Welding (GMAW)(Mig) and Flux Core Arc Welding (FCAW)	I-5 Perform Plasma Arc Cutting (PAC)								

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Duties	Tasks →												
J — Perform Drafting Tasks	J-1 Demonstrate traditional mechanical drafting skills	J-2 Use Computer-Aided Drafting (CAD) system	J-3 Create 3-D solid models	J-4 Make tool drawings									
K — Use Computers	K-1 Use computer operating systems	K-2 Use computer inquiry systems	K-3 Use various computer applications	K-4 Recommend and implement CIM technologies	K-5 Use computer-aided engineering system								
L — Participate in Total Quality and SPC Activities	L-1 Define quality in manufacturing and explain importance	L-2 Implement concepts of quality in the workplace	L-3 Apply principles and tools of continuous quality improvement	L-4 Understand and apply SPC	L-5 Evaluate data to monitor production	L-6 Analyze customer problems and recommend solutions	L-7 Establish methods, plans and procedures to maintain quality						
M — Maintain Electrical Devices	M-1 Use electrical test equipment	M-2 Apply specific terms to electrical circuits	M-3 Analyze series, parallel and complex DC/AC circuits	M-4 Check AC and DC motors	M-5 Inspect transformers and generators	M-6 Discuss sensors and feedback technology	M-7 Set up/ program PLC	M-8 Troubleshoot electrical devices					
N — Maintain Hydraulic/ Pneumatic Devices	N-1 Use test equipment	N-2 Describe basic principles of hydraulic systems	N-3 Identify hydraulic fluids	N-4 Recommend power distribution and sealing devices	N-5 Recognize pumps, actuators, and hydraulic control devices	N-6 Troubleshoot hydraulic/pneumatic systems							

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THE MAST TECHNICAL WORKPLACE COMPETENCY OUTLINE

The Competency Profiles derived from the industry survey process were returned to industry and faculty members at each MAST partner college for review. Reviewers were asked to identify specific sub-tasks within each block of Duties and Tasks in the Profile; MAST staff at each college broke the sub-tasks down further into the detailed steps required to actually perform the duties and tasks of the manufacturing process. It is these detailed skill standards that were then incorporated into development of the curriculum and piloted as a training program by each of the MAST colleges. All results for the specific occupational specialty area have been organized as an outline of the duties, tasks, and sub-tasks required to demonstrate technical competency in the workplace, as shown in the following pages.

As a result of the Texas and the National Surveys, additional refinements were made to the Competency Outlines. These changes were then incorporated into the individual course syllabi.

The MAST Technical Workplace Competency Outline for this occupational specialty area has been included on the following pages.

MANUFACTURING ENGINEERING TECHNICIAN
TECHNICAL WORKPLACE COMPETENCIES

MANUFACTURING ENGINEERING TECHNICIAN--*use special knowledge and skills to recommend and/or implement solutions for specific manufacturing applications.*

A. PRACTICE SAFETY

1. Follow Safety Manuals and All Safety Regulations/Requirements
   a. Assume responsibility for the personal safety of oneself and others
   b. Develop a personal attitude towards safety
   c. Interpret safety manual directives
   d. Comply with established company safety practices
   e. Complete forms/paperwork as required
2. Use Protective Equipment
   a. Wear protective safety clothing as required
   b. Maintain and use protective guards and equipment on machinery
   c. Locate and properly use protective equipment
   d. Use lifting aids when necessary
3. Follow Safe Operating Procedures for Hand and Machine Tools
   a. Identify and understand safe machine operating procedures
   b. Demonstrate safe machine operation
4. Maintain a Clean and Safe Work Environment
   a. Keep work areas clean
   b. Clean machine/hand tools when work is completed
   c. Put tools away when work is finished
   d. Keep aisles clear of equipment and materials
   e. Perform preventative maintenance as required
5. Control Fire Hazards
   a. Handle/store flammable materials appropriately
   b. Use electricity correctly (e.g., defective outlets, frayed cords, "burning" odor)
   c. Prevent spontaneous ignition by practicing proper waste disposal habits
   d. Keep marked aisles clear of equipment and materials
   e. Interpret/display MSDS sheets as required
   f. Identify fire exits and fire-fighting equipment
6. Apply American Red Cross First Aid and CPR Procedures
   a. Notify appropriate personnel of injury
   b. Check and evaluate life-endangering conditions
   c. Determine need for CPR
   d. Apply appropriate first aid techniques
   e. Complete accident report as needed
7. Recommend Hazardous Waste Management Techniques
   a. Define the types of hazards (e.g., chemical, biological, and physical)
   b. Understand chemical hazards and the use of Material Safety Data Sheets (MSDS)
   d. Describe the proper collection for a variety of hazardous wastes
   e. Respond to emergencies in the appropriate manner
8. Apply Ergonomic Principles to the Workplace

a. Define ergonomics
b. Explain the characteristics and potential impact of ergonomics on design, productivity, and safety

9. Demonstrate Knowledge of State and Federal EPA Regulations
   a. Meet health, safety, and legal requirements with regard to process, product and people

B. APPLY MATHEMATICAL CONCEPTS

1. Perform Basic Arithmetic Functions
   a. Add, subtract, multiply and divide whole numbers
   b. Add, subtract, multiply, and divide fractions
   c. Add, subtract, multiply, and divide decimals
2. Interconvert Fractions/Decimals
   a. Convert fractions to decimal equivalents
   b. Convert decimal values to nearest fractional equivalent
   c. Use decimal equivalent chart for conversions
3. Interconvert Metric/Inch Measurements
   a. Convert inch dimensions to metric
   b. Convert metric dimensions to inch
   c. Use metric/inch conversion chart
4. Perform Basic Algebraic Operations
   a. Express word statements as algebraic equations
   b. Solve word statements as algebraic equations
5. Perform Basic Trigonometric Functions
   a. Solve for unknown angles
   b. Solve for unknown sides
   c. Calculate bolt hole patterns
6. Calculate Speeds and Feeds for Machining
   a. Calculate RPM for various metals and various tools
   b. Calculate feed for various metals, tools, and depths of cut
7. Locate Machining Points from a Datum Point
   a. Identify points using the Cartesian coordinate system
   b. Identify points using the absolute dimensioning system
   c. Identify points using the incremental dimensioning system
   d. Identify points using the polar coordinate system
8. Perform Calculations for Sine Bar and Sine Plate
   a. Calculate gage block build up for 5" sine bar
   b. Calculate gage block build up for 10" sine plate
9. Calculate for Direct, Simple, and Angular Indexing
   a. Calculate for direct indexing
   b. Calculate for simple indexing (plain)
   c. Calculate for angular indexing
   d. Use Machinery's Handbook for calculations
10. Perform Calculations Necessary for Turning Tapers
    a. Calculate tail stock offset
    b. Determine unknowns (e.g., small and/or large diameters) for taper turning
11. Calculate Depth of Cut on Round Surfaces
    a. Calculate depth of cut for flats to be machined on cylindrical pieces

b. Calculate depth of cut for keyways which are machined on cylindrical pieces

12. Use all Functions on a Scientific Calculator
    a. Apply all trigonometric functions
    b. Apply all algebraic functions
    c. Apply all statistical functions
13. Solve Engineering Equations
    a. Solve linear algebraic equations for an unknown
    b. Solve a system of linear equations with 2 unknowns
    c. Solve right triangles for unknown sides or unknown angles
    d. Use law of sines and cosines to solve obtuse triangles with unknown sides and angles
    e. Operate hand held electronic calculator properly (w/trigonometry keys)
    f. Discuss friction (e.g., coefficient, angle of friction, and angle of repose)
14. Solve Static Systems for Resultant Force
    a. Solve for the following coplanar force systems: parallel, concurrent, and nonconcurrent
    b. Solve for the following nonpoplanar force systems: parallel, concurrent, and nonconcurrent
15. Determine Strength of Materials for Various Applications
    a. Discuss stress and deformation
    b. List properties of materials (e.g., strength, elasticity, stiffness, ductility, hardness)
    c. Calculate stresses and designs of joints
    d. Discuss advantages and disadvantages of different fastening technique
    e. Discuss problems relating to torque-twisting moments
    f. Discuss centroids and moments of inertia of areas

C. INTERPRET ENGINEERING DRAWINGS AND CONTROL DOCUMENTS

1. Review Blueprint Notes and Dimensions
    a. Explain basic blueprint terminology
    b. Identify the types of dimensions
    c. Identify general note symbols
    d. Locate notes on a print
    e. Interpret commonly used abbreviations and terminology
    f. Determine tolerances associated with dimensions on a drawing
    g. Determine the tolerance for a reference dimension
    h. Determine the surface finish for a given part
    i. List the essential components found in the general drawing notes
2. Identify Basic Layout of Drawings
    a. Identify types of lines within a drawing
    b. Identify item number symbols
    c. Identify general note symbols
    d. List the essential components found in the title block
    e. Locate bill of materials in a drawing
    f. List the components found in the revision block
3. Identify Basic Types of Drawings
    a. Identify orthographic views

b. Identify positions of views (top, front, side, and auxiliary)
c. Visualize one or more views from a given view
d. Identify isometric views
e. Identify exploded isometric drawings
f. Identify assembly drawings

4. List the Purpose of Each Type of Drawing
   a. Discuss purpose of orthographic (3 views) drawings
   b. Discuss purpose of isometric drawing
   c. Discuss purpose of exploded isometric drawing
   d. Discuss purpose of assembly drawings
5. Verify Drawing Elements
   a. Determine the scale of the view or section
   b. Check for revisions
   c. Recognize out-of-date blueprints
6. Practice Geometric Dimensioning and Tolerancing (GD&T) Methodology
   a. Identify the purpose of GD&T
   b. Identify symbols for controlling location (or true position) of part features
   c. Identify symbols for controlling form (or alignment) of part features
   d. Identify symbols for showing datums and basic dimensions on drawings
   e. Identify symbols for Maximum Material Size (MMS) and Regardless of Feature Size (RFS)
7. Describe the Relationship of Engineering Drawings to Planning
   a. Discuss production schedule
   b. Discuss Material Resource Planning (MRP)
   c. Discuss inventory control records
   d. Discuss shop floor routing documents
8. Use Standards to Verify Requirements
   a. Discuss the purpose of standards
   b. Discuss source locations for standards
9. Analyze Bill of Materials (BOM)
   a. Discuss components found on BOM
   b. Determine materials needed to produce the part
   c. Determine quantities necessary to produce the part
   d. Submit completed stock request form as required
   e. Submit completed tool request form as needed
10. Understand and Use Quality Systems
    a. Describe ISO 9000 quality system
    b. Document paper trails for document revisions

D. RECOGNIZE DIFFERENT MANUFACTURING MATERIALS AND PROCESSES

1. Identify Materials With Desired Properties
   a. Discuss classification system for metals
   b. Discuss general characteristics for carbon steels, tool steels, stainless steels, structural steels, cast irons, aluminum, and other commonly used metals
   c. List advantages for considering plastic as a viable materials choice
   d. List the advantages and disadvantages for each of the following plastic molding processes: blow, injection, vacuum, extrusion, etc.

e. Discuss the advantages for using composites in various manufacturing applications

2. Identify Materials and Processes to Produce a Product
   a. Discuss service requirements (in strength, hardness, etc.)
   b. Discuss fastening processes (i.e., fasteners, welding, bonding, etc.)
   c. Discuss corrosion resistance methods
3. Describe Heat Treating Processes
   a. Discuss the reasons for heat treating
   b. Discuss the time/temperature chart
   c. List the different quenching mediums
   d. Estimate metal heat temperature by color
   e. List reasons for stress relieving workpieces
   f. Discuss surface hardening processes
4. Perform Heat Treating Operations
   a. Harden plain carbon workpiece
   b. Temper plain carbon workpiece
   c. Anneal plain carbon workpiece
   d. Case harden workpiece
5. Test Metal Samples for Hardness
   a. Perform spark test to test for metal hardness
   b. Perform Rockwell hardness tests
   c. Perform Brinell hardness tests
   d. Perform Charpy and/or Izod impact tests
   e. Perform tensile and/or compression tests
   f. Prepare metal samples for viewing under a microscope
6. Describe Casting Processes
   a. Discuss the following casting processes: sand, evaporative, shell molding, permanent mold, centrifugal, investment, and die casting
   b. Discuss pattern and mold design factors for each of the above casting processes
   c. List the advantages and disadvantages of the casting processes
7. Describe Hot Working Processes
   a. Discuss the following hot working processes: rolling, strand casting, forging, drawing, extrusion, spinning, and roll forming
   b. List the advantages and disadvantages of the hot working processes
8. Describe Cold Working Processes
   a. Discuss the following cold working processes: rolling, blanking, pressing, drawing, extruding, wire and bar drawing, bending, shearing, and roll forming
   b. List the advantages and disadvantages of the cold working process
9. Evaluate Alternative Manufacturing Processes
   a. Discuss the powder metallurgy process (PM)
   b. Discuss the following nontraditional machining processes: EDM, Laser machining, Ultrasonic machining, Hydrojet machining, Electron beam machining, and plasma beam machining

E. DEMONSTRATE MEASUREMENT/INSPECTION TECHNIQUES

1. Identify Types of Measurement

a. Discuss the use of metrology in manufacturing
b. Discuss the inch system of measurement
c. Discuss the metric system of measurement
d. Discuss semi-precision and precision measurement
e. Discuss the following: accuracy, precision, reliability, and discrimination

2. Select Proper Measurement Tools
   a. Identify basic semi-precision measuring tools
   b. Identify precision measuring tools
   c. Justify the use of a particular measuring tool based on tool characteristics
   d. Identify error possibilities in measurement tool selection
   e. Demonstrate proper care of precision measuring tools
3. Apply Proper Measuring Techniques
   a. Discuss factors affecting accurate measurement (dirt, temperature, improper measuring tool calibration)
   b. Explain calibration requirements of various precision instruments
   c. Illustrate measurement differences when taken with calibrated and non-calibrated instruments
   d. Calibrate a micrometer type measuring tool
4. Perform Measurements With Hand Held Instruments
   a. Measure with steel rules (metric and inch)
   b. Measure with micrometers
   c. Measure with comparison measuring instruments (e.g., calipers, telescope gages)
   d. Measure with direct measuring instruments (e.g., vernier, dial, and digital instruments)
   e. Measure with fixed gages (go and not go gages)
5. Perform Measurements on Surface Plate
   a. Describe care of surface plate
   b. Use surface plate accessories correctly (sine bar, gage blocks, etc.)
   c. Check for part squareness
   d. Check part dimensions for accuracy
   e. Align workpieces using height gage and dial indicators
6. Perform Inspections Using Stationary Equipment
   a. Set up and use an Optical Comparator
   b. Set up and use a Coordinate Measuring Machine (CMM)

F. PERFORM CONVENTIONAL MACHINING OPERATIONS

1. Prepare and Plan For Machining Operations
   a. Read and interpret blueprints
   b. Perform basic semi-precision and precision layout as necessary
   c. Plan machining operations
   d. Understand machinability and chip formation
   e. Calculate speeds, feeds, and depth of cut for various machine applications
   f. Determine proper cutting fluids/coolants for machining
   g. Use carbides and other tool materials to increase productivity
   h. Use the Machinery's Handbook as a reference for machine applications
2. Use Proper Hand Tools
   a. Use arbor and shop presses

b. Select necessary work-holding devices and hand tools as needed
c. Select and use hand files
d. Identify and use hand reamers
e. Correctly identify and use hand taps as required
f Follow tapping procedures to produce internal threads
g. Use thread-cutting dies to produce external threads
h. Operate bench and pedestal grinders safely

3. Operate Power Saws
   a. Use reciprocating and horizontal band cutoff machines
   b. Operate abrasive and cold saws
   c. Prepare and use the vertical band saw
   d. Weld a bandsaw blade
4. Operate Drill Presses
   a. Describe the different types of drill presses found in the machine shop
   b. Describe and use standard drilling tools
   c. Sharpen a drill bit using a bench or pedestal grinder
   d. Setup the drill presses for drilling, countersinking, counterboring, reaming, and tapping operations
   e. Drill holes using drill jigs
5. Operate Vertical Milling Machines
   a. Demonstrate the use of all controls on the vertical milling machine
   b. Align the vertical milling machine head
   c. Select, align and use workholding devices
   d. Select milling tool holders
   e. Select milling cutters
   f. Perform all standard vertical milling operations
   g. Bore a hole using the offset boring head
   h. Machine angles using sine bar and gage blocks
   i. Setup and use special vertical mill fixtures
   j. Setup and machine dovetails
   k. Machine keyways
6. Operate Horizontal Milling Machines
   a. Discuss the difference in plain and universal horizontal milling machines
   b. Discuss the types of spindles, arbors and adaptors used on the horizontal milling machine
   c. List several common work holding methods
   d. Use plain milling cutters
   e. Use side milling cutters
   f. Use face milling cutters
   g. Setup and use special horizontal mill fixtures
7. Operate Metal Cutting Lathes
   a. Demonstrate the use of all controls on the engine lathe
   b. Discuss standard tools and toolholders for the lathe
   c. Face and center drill parts correctly
   d. Drill, ream and bore on the lathe
   e. Turn between centers
   f. Discuss alignment of lathe centers

g. Make all calculations, lathe adjustments and settings to machine UNF and UNC series threads
h. Discuss thread fit classifications
i. Describe the common tapers used in the machine shop
j. Discuss taper cutting and calculations for the lathe
k. Setup and use the taper attachment found on most lathes
l. Use follower rests and steady rests
n. Use HSS cutting tools
o. Use carbide cutting tools

8. Operate Grinding/Abrasive Machines
   a. Discuss the selection and identification of grinding wheels
   b. Inspect, mount, true, dress, and balance grinding wheels
   c. Discuss the selection of grinding fluids
   d. Operate horizontal spindle reciprocating table surface grinders
   e. Discuss common problems and solutions in surface grinding

G. PERFORM ADVANCED MACHINING PROCESSES

1. Prepare and Plan For CNC Machining Operations
   a. Read and interpret blueprints
   b. Plan CNC machining operations
   c. Calculate speeds, feeds, and depth of cut for various CNC machine applications
   d. Determine proper cutting fluids/coolants for CNC machining
   e. Use the Machinery's Handbook as a reference for CNC machine applications
2. Select and Use CNC Tooling Systems
   a. Understand machinability and chip formation
   b. Select proper insert materials and geometry
   c. Assemble tooling components
   d. Select correct tooling systems
   e. Identify tooling cost factors
3. Program CNC Machines
   a. Identify CNC applications
   b. List various types of CNC machines
   c. Discuss CNC machine control systems
   d. Describe absolute and incremental coordinate systems
   e. Plan and write programs for CNC lathes
   f. Plan and write programs for CNC mills
4. Operate CNC Machining Centers (Mills)
   a. Install and align work holding devices
   b. Load/align materials into the machine
   c. Load tools into machine
   d. Establish tool length offset for each tool
   e. Establish/set machine reference
   f. Load programs into CNC mill
   g. Demonstrate working knowledge of all controls on the MCU
   h. Demonstrate proper operation of CNC machining center to include "dry run" and final production

i. Edit CNC programs for optimum part production
j. Operate machine in DNC mode if that capability exists

5. Operate CNC Turning Centers (Lathes)
   a. Install and bore soft jaws as required
   b. Load tools into machine
   c. Establish machine reference
   d. Set initial tool offsets
   e. Monitor/adjust offsets for accurate part production
   f. Load programs into CNC lathe
   g. Demonstrate working knowledge of all controls on the MCU
   h. Demonstrate proper operation of CNC lathe to include "dry run" and final production
   i. Edit CNC programs for optimum part production
   j. Replenish stock in bar feeder as needed
6. Operate Electrical Discharge Machines
   a. Discuss the EDM process
   b. List advantages and disadvantages of the EDM process
   c. Identify electrode materials
   d. Machine EDM electrodes
   e. Setup and operate die sinker EDM machines
   f. Calculate overburn
   g. Identify generator setting of machine
   h. Choose proper techniques for flushing
   i. Estimate number of roughers and finishers
   j. Demonstrate proper electrode mounting techniques
   k. Utilize 3R tooling
   l. Perform touch-off procedures
   m. Recognize optimum machine settings
   n. Perform continuity checks
   o. Determine R-MAX finish required
   p. Setup and operate wire cut EDM machines
7. Download Programs Via Network
   a. Download programs from the network
   b. Upload programs to the network
   c. Perform edit and print functions via network
8. Program CNC Machines Using a CAM System
   a. Create Job Plan for machining operations
   b. Construct part geometry
   c. Program tool path for roughing and finishing operations
   d. Verify tool path
   e. Generate CNC code

H. PERFORM DRAFTING TASKS.

1. Demonstrate Traditional Mechanical Drafting Skills
   a. Form freehand vertical Gothic upper-case letters and numerals of correct shape and space
   b. Execute the alphabet of lines correctly, producing dense black lines of uniform thickness and spacing

c. Demonstrate proficiency with the engineers and metric scales
d. Execute geometric constructions with no mistakes in tangent points, line quality or layout work
e. Accurately draw the missing view or line in a multiview drawing
f. Make or complete a sectional instrument drawing, given one or more views
g. Develop satisfactory working drawings of simple machine components to include all necessary views and dimensions for complete shape and size description of detail parts
h. Discuss the differences in standard engineering drawings and tool drawings
i. Develop satisfactory tool drawings for drill jigs, milling fixture, and inspection fixtures

2. Use Computer-Aided Drafting (CAD) System
   a. Demonstrate the start-up and shut-down of a PC based CAD system
   b. Input information through the use of various input devices
   c. Use the SETTINGS menu commands to establish operating parameters in a drawing
   d. Use the Cartesian coordinate system to correctly enter line and arc elements to construct a part
   e. Use the DISPLAY menu to manipulate the drawing image
   f. Apply basic DRAW menu and EDIT menu commands to create a drawing
   g. Use appropriate menu commands to manage files
   h. Set up the specifications within the PLOT command for producing a hard copy of a drawing
   i. Convert to accepted drawing exchanges formats (i.e., IGES, DXF, etc.)
   j. Convert CAD data to a CAM system
   k. Use a CAD system for producing tool drawings
3. Create 3-D Solid Models
   a. Construct the required geometrical elements required for the model
   b. Assign necessary properties for the creation of the solid model
   c. Perform engineering tests on the solid model
4. Make Tool Drawings
   a. Discuss the differences in tool drawings verses regular mechanical drawings
   b. Design and draw a simple drill jig using accepted practices
   c. Design and draw a simple milling fixture using accepted practices

I. USE COMPUTERS

1. Use Computer Operating Systems
   a. Use basic computer terminology appropriately and accurately
   b. Boot the computer and recognize the basic components of DOS
   c. Use DOS to perform file management
   d. Use DOS to perform directory management
   e. Install software packages on a PC
2. Use Computer Inquiry Systems
   a. Log in to a multi-user system
   b. Access system for needed information
   c. Print reports as necessary
3. Use Various Computer Applications

a. Load word processor, create, save, edit, and print a document
b. Load spreadsheet, create, save, retrieve, erase, edit, and print a worksheet
c. Load database programs, create, edit, delete, and print records in a database file

4. Recommend and Implement CIM Technologies
   a. Use automatic storage & retrieval system
   b. Use bar coding technology
   c. Understand robot applications
   d. Program robots
   e. Use shop floor control systems
   f. Understand machine vision systems
5. Use Computer-Aided Engineering System
   a. Perform structural loading tests
   b. Perform finite element analysis tasks
   c. Perform interference tests

J. PARTICIPATE IN TOTAL QUALITY, TEAMWORK, EMPOWERMENT, QUALITY PROBLEM SOLVING AND STATISTICAL PROCESS CONTROL

1. Discuss the Role of Total Quality Management (TQM) in Manufacturing (TQM^2)
   a. Understand the history of Total Quality Management process and its major historical contributors Deming, Juran, and Crosby
   b. State the reason for intensive application of Total Quality Management principles, concepts and constitution parts in the industrial work places of America
   c. Identify the parts of the of the Total Quality Management formula (or the major element of TQM) - $TQM=(T^5 + SPC) X CI + E\&CS = P\&S$
   d. Understand the vital interplay of Training, Trust, Teamwork, Total Involvement and Transformation ($T^{5)}$ to the successful implementation of TQM^2
   e. Understand the need for quantitative tools to base quality decisions on objective measurable information (Statistical Process Control - SPC)
   f. Understand how Continuous Improvement (CI) is a vital philosophy with the power to multiply quality efforts of TQM^2
   g. State the importance of Employee and Customer Satisfaction (E&CS) to the successful implementation of TQM^2
   h. Understand how the meaning of quality is determined based on the prospective of supplier and customer
   i. Understand that the quality perceptions of the customer are of prime importance
   j. Identify external and internal customers and the importance of both to the successful implementation of TQM^2
   k. Know the essential importance of the Total Quality Management formula and its constitution parts to the Profitability and Survivability of a manufacturing enterprise
   l. Understand the importance of National TQM awards
2. Discuss Team Work (Teaming) Concepts
   a. Understand how successful implementation of Teamwork is fundamental to the successful implementation of TQM^2

b. Identify the basic theories and concepts that allow for the development of effective teams in a manufacturing setting
c. Identify the stages in building a functioning manufacturing team
d. Identify the roes that must be fulfilled for teams to function effectively
e. Identify the responsibilities of sponsoring manager(s), team leader, recorder, facilitator, and member
f. Be able to function in each of the roles of leader, recorder, facilitator and member
g. Understand how team norms or guidelines are vital to an effective team
h. Identify and practice team building behaviors
i. Identify and be able to counter team subverting or destructive behaviors
j. Understand the dynamic and desirable tension between diversity and conflict on teams
l. Identify and practice methods for containing conflict with out retarding creativity within teams
m. Understand the dynamic and desirable tension between consensus and group think
n. Identify the four ways to reach a decision
o. Understand the desirability of reaching a consensus
q. Identify the eight factors that lead to group think and how to negate them

3. Demonstrate Empowerment Techniques
   a. Understand how successful implementation of TQM^2 and Teamwork in the manufacturing environment will inevitably lead to empowerment
   b. List the benefits to be gained by both management and labor from the implementation of Empowerment in a manufacturing setting
   c. Define Empowerment as a process that helps the right people at the right levels make the right decisions for the right reasons
   d. List and explain the two sides (facilitating empowerment in others and self empowerment) and four dimensions of empowerment (time, alignment, capability and trust)
   e. Appreciate the need to make it possible for others to be empowered by valuing individuals, establish vision, providing tools, encouraging independent action and building empowerment systems
   f. Understand the need for delegation and the dos and don'ts of delegation
   g. Be able to empower themselves through recognizing and operating from their own power, creating a personal vision, using the power tools, taking independent action and contributing to the empowerment process
4. Demonstrate Knowledge of Quality Problem Solving (Six-Step Problem Solving Model) Techniques
   a. Understand the need in today's fast faced business environment to improve manufacturing processes and efficiency through the diligent use of a problem solving model
   b. Be able to identify the six steps of the six-step problem solving model
   c. Be able to identify each of the sub-steps of the six-step problem solving model
   d. Be able to apply the six-step problem solving model in individual and in team situations within the manufacturing environment

e. Understand the "Circle of Influence" phenomenon and its impact on successful problem solving in the manufacturing environment
f. Be able to use problem solving tools, e.g., brainstorming, cause and affect diagram, paired choice matrix, and the criteria ranking form

5. Demonstrate Knowledge of Statistical Process Control (SPC) Concepts
a. Understand basic statistic for manufacturing process control
b. Be able to define variation and probability
c. Be able to identify the difference between "natural variation" and "unnatural variation"
d. Be able to describe the difference between expected occurrence and actual occurrences of an event
e. Be able to identify a histogram
f. Recognize and describe the normal distribution curve
g. Understand the usefulness of the normal or bell curve to SPC
h. Be able to explain how the area under the normal curve is divided into standard deviations, or sigma (σ) units
i. Define and calculate mean and range
j. Apply a formula to estimate standard deviation
k. Describe the relationship between the distributions of individuals and sample averages
l. Be able to state the purpose of a control chart
m. Identify the central line of a control chart
n. Explain the difference between control limits and engineering specifications or tolerances
p. Describe why the control chart has so much power
0. Describe the purpose of a process capability study
q. Define control chart variables and explain what X "bar" and R charts illustrate about a manufacturing process
r. Explain the relationship between X "bar" (mean of sample) and R (range) of samples
s. Define attributes and explain what p charts tell about a manufacturing process
t. Be able to interpret control charts by identifying the patter of points that shows the presence of a normal distribution
u. Be able to recognize the five signs that show a process may be out of control

K. MAINTAIN ELECTRICAL DEVICES

1. Use Electrical Test Equipment
a. Measure resistance with an analog volt-ohm-milliamp meter
b. Measure voltage with volt-ohm-milliamp meter
c. Measure current with volt-ohm milliamp meter
d. Use wattmeter to measure power in a simple DC circuit
e. Use oscilloscope to observe AC signals of various waveshapes and frequencies

2. Apply Specific Terms to Electrical Circuits
a. Define voltage, current, and resistance
b. Discuss power, power factor, and sine waves

c. Define three phase, induction, and capacitance

3. Analyze Series, Parallel and Complex DC/AC Circuits
   a. Define a series circuit
   b. Define a parallel circuit
   c. Define a complex DC circuit
   d. Define an AC circuit
   e. Apply Ohm's law to each of the above circuits
   f. Apply Kirchoff's law to each of the above circuits
4. Check AC and DC Motors
   a. List types of AC and DC motors
   b. List characteristics of AC motors
   c. List characteristics of DC motors
   d. Compare AC motors versus DC motors to job duty
5. Inspect Transformers and Generators
   a. Define transformer construction and the principle of operation
   b. List the different types of transformers
   c. Define electro-magnetic induction
   d. Describe the principle of operation of AC alternators and DC generators
6. Discuss Sensors and Feedback Technology
   a. List the various types of feedback devices used in industrial controls
   b. Apply the use of feedback systems in industrial control circuitry including AC, DC, and servo drive systems
   c. Identify, hardwire, and troubleshoot electro-mechanical devices and electrical switching devices including proximity switches, infra-red, and magnetic sensors
7. Set Up/Program PLC
   a. Describe the function and operation of three basic components of programmable controllers
   b. Revise electrical ladder control diagrams as reference diagrams to be programmed into the user memory of the programmable controller
   c. Use the programming devices to program, monitor, and edit the programmable controller
   d. Design and develop programs using standard functions and special standard functions of the programmable controller
   e. Troubleshoot functional circuits using reference diagram, indication lights, and programming devices
8. Troubleshoot Electrical Devices
   a. Discuss common methods of troubleshooting electrical systems
   b. Follow a logical troubleshooting sequence to trace a problem to its origin

L. MAINTAIN HYDRAULIC/PNEUMATIC DEVICES

1. Use Test Equipment
   a. Monitor hydraulic flow with flow meters
   b. Use temperature gauges to determine hydraulic fluid operating temperature
   c. Use flow control valves, U-tube manometers and pressure gauges to measure operating conditions for the fluid power system
2. Describe Basic Principles of Hydraulic Systems
   a. List advantages of hydraulic systems

b. Identify components of typical hydraulic system
c. State or describe Pascal's law
d. Analyze a hydraulic system to determine its performance

3. Identify Hydraulic Fluids
   a. Name types of hydraulic fluids
   b. List methods of measuring fluid viscosity
   c. List desirable characteristics of hydraulic fluids
   d. Identify safety hazards related to hydraulic fluid use
   e. Discuss heat exchangers, filters, and micron rating of filters
4. Recommend Power Distribution and Sealing Devices
   a. Describe proper identification and selection of lines, hoses, and fittings
   b. Discuss pressure, velocity, and safety factors
   c. List conditions determining selection of sealing devices
5. Recognize Pumps, Actuators, and Hydraulic Control Devices
   a. Name general classifications of pumps
   b. Determine overall pump efficiency
   c. Name types of positive displacement pumps and give advantages and disadvantages of each
   d. Discuss types of variable delivery pumps and describe their operation
   e. Describe linear actuators (cylinders)
   f. Describe how cylinders are rated and sized
   g. Describe rotary actuators and motors
   h. Name two types of hydraulic motors
6. Troubleshoot Hydraulic/Pneumatic Systems
   a. Discuss common methods of troubleshooting hydraulic systems
   b. Follow a logical troubleshooting sequence to trace a problem to its origin

THE MAST PILOT PROGRAM CURRICULUM AND COURSE DESCRIPTIONS

After completing the Competency Profile and Technical Workplace Competency Outline for each occupational specialty area, each MAST partner reviewed their existing curricula against the industry-verified skill standards in order to identify a suitable foundation for new pilot training programs. Because each college had to comply with the requirements of its respective college system and appropriate state agency, the resulting pilot curricula for occupational specialty areas tended to vary in format and academic requirements (e.g., some programs were based on the semester system, others on the quarter system). Despite differences in the curricula developed at the partner colleges, each of the pilot programs was designed to achieve the following two goals mandated in the MAST grant proposal:

- Pilot Program: "Conduct a one year pilot program with 25 or more selected applicants at each college or advanced technology center to evaluate laboratory content and effectiveness, as measured by demonstrated competencies and indicators of each program area."

- Student Assessment: "Identify global skills competencies of program applicants both at point of entrance and point of exit for entry level and already-employed technicians."

(Note: All occupational specialty areas were not pilot tested at all Development Centers; however, all partner colleges conducted one or more pilot programs.)

Included on the following pages is the curriculum listing for the pilot program which was used to validate course syllabi for this occupational specialty area. This curriculum listing included course names and numbers from the college which conducted the pilot program. The curriculum also shows the number of hours assigned to each of the courses (lecture, lab and credit hours). Also included is a description of each of the courses.

MANUFACTURING ENGINEERING TECHNOLOGY
COMPUTER AIDED MANUFACTURING OPTION
CURRICULUM
1995-96

		LEC	LAB	CR
FIRST QUARTER				
PSYC 1100*	College Success Skills	1	0	1
MET 100	Machine Tool Practices I	3	9	6
DDT 104	Drafting Principles	2	4	3
MATH 1314*	College Algebra	4	0	3
ENGL 1301*	Composition I	4	0	3
		14	13	16
SECOND QUARTER				
MET 200	Machine Tool Practices II	3	9	6
ENGL 134*	Interpersonal Communication	4	0	3
MATH 1316*	Plane Trigonometry	4	0	3
CNS 2060	Application Software	2	4	3
		13	13	15
THIRD QUARTER				
MET 112	Engineering Materials	2	3	3
OSH 216	Safety and Accident Prevention	2	3	3
PHY 114	Basic Fluid Power	3	3	4
EST 120	Electrical Applications	3	3	4
WLT 105	Survey of Welding Applications and Processes	3	3	4
		13	15	18
FOURTH QUARTER				
MET 205	CNC Machine Programming	3	3	4
MET 206	Statics	3	3	4
MET 301	Manufacturing Processes	3	3	4
DDT 128	Introduction to Computer Drafting	1	4	2
PSYC 2301*	General Psychology	4	0	3
		14	13	17
FIFTH QUARTER				
MET 302	CAD/CAM I	3	3	4
MET 216	Tool Design I	2	6	4
MET 312	Strength of Materials	3	3	4
PHYS 1310*	Elementary Physics	4	0	3
	Free Elective	2	0	2
		14	12	17

SIXTH QUARTER				
MET 318	CAD/CAM II	3	3	4
MET 315	Computer Integrated Manufacturing	2	2	3
MET 324	Quality Assurance and Statistical Process Control	2	3	3
MET 322	Engineering Technology Project	4	6	6
		11	14	16
	Program Totals	79	80	99

* Course Syllabi in Volume 2

MANUFACTURING ENGINEERING TECHNOLOGY
COMPUTER AIDED MANUFACTURING OPTION
COURSE DESCRIPTIONS 1995-1996

MET 100 **Machine Tool Practices I** (3-9-6) Students will be assigned, specially designed projects that will be machined using the engine lathe, milling, machine, drill press, and various saws. The capability and safe use of the machine tools will be stressed.

MET 112 **Engineering Materials** (2-3-3) A study of metallic and nonmetallic materials used in design including properties, characteristics, and methods of conducting common tests and interpreting data.

MET 200 **Machine Tool Practices II** (3-9-6) A course designed to develop additional machine shop skills for those students who were successful in Machine Tool Practices I.

MET 205 **CNC Machine Programming** (3-3-4) A course in the programming and operation of a computerized numerical control milling machine using manual machine language. Included will be linear and circular interpolation, drilling cycle, and repetitive programming. Prerequisites: MET 100

MET 206 **Statics** (3-3-4) An introduction to the field of engineering mechanics covering the calculation of forces and moments acting on machine parts, frames and structures. The equilibrium of concurrent and coplanar force systems, centroids and friction are studied. Prerequisite: MATH 1316 or concurrent enrollment

MET 216 **Tool Design I** (2-6-4) Students will set up and machine work pieces using the lathe, vertical mill, drill press, and surface grinder. Fasteners, surface finish, machining techniques typical of tool and die making will be used. Prerequisites: MET 100 and DDT 104.

MET 301 **Manufacturing Processes** (3-3-4) Essential studies into the processes and materials for manufacturing, including metal casting, hot and cold forming of steel, powder metallurgy and plastics. Analysis of newer processes such as electrical discharge machining, chemical machining and ultrasonic machining with an emphasis on the economical manufacturing of products.

MET 302 **CAD/CAM I** (3-3-4) This course will provide an introduction to "Process Modeling" utilizing the CNC graphics programming system; "SMARTCAM". Using engineering drawings, students will program various parts for both CNC mills and CNC lathes. Related topics include: job planning, tool selection, construction of a process model, tool path verification, simulation, quality control, CAD/CAM data transfer, and CNC code generation.

MET 312 **Strength of Materials** (3-3-4) A study of the relationship existing between externally applied forces and internally induced stresses, and the resulting deformations of structural members. Prerequisite: MET 206.

MET 315 **Computer Integrated Manufacturing** (2-2-3) An understanding into the fundamentals of (CIM). This includes the key elements and technologies involved, the typical applications that exist in industry today and the major trends that will affect the future of manufacturing.

MET 318 **CAD/CAM II** (3-3-4) A continuation of MET 302 with advanced utilization of "SMARTCAM". Topics will include the following: 3-D Process Modeling, creation and utilization of different work planes, 4th and 5th axis programming, creation of tool path for surface primitives, swept surfaces, translated surfaces, sculpted surfaces, ruled surfaces, and coons surfaces. Additional topics include: projecting, intersecting, blending, and trimming one surface to another surface. Students will program both a simple punch and die set and a simple injection mold cavity. Prerequisite: MET 302.

MET 322 **Engineering Technology Project** (4-6-6) Different industrial level projects emphasizing manufacturing applications/research in the areas of CAD/CAM, CIM or plastics will be assigned to students utilizing a team concept. Prerequisites: MET 302 and MET 312

MET 324 **Quality Assurance and Statistical Process Control** (2-3-3) An introduction to the concepts of applied quality control systems. Topics covered includ equality responsibility, control chart methods, samplings techniques, reliability applications and computer utilization/programs.

MANUFACTURING ENGINEERING TECHNOLOGY
COMPUTER AIDED MANUFACTURING OPTION
SUPPORT COURSES
1995-1996

PSYC 1100*	**College Success Skills** This course acquaints the students with the policies of the college, services available on and off the campus, and study skills along with other issues that will help them through their college studies. Students are required to take this course in their first quarter at TSTC.
DDT 104	**Drafting Principles** A course consisting of basic exercises in lettering, use of the instruments, technical sketching, geometric construction, orthographic projection, auxiliary views, and dimensioning. Working drawings will be made.
MATH 1314*	**College Algebra** A study of quadratics; polynomial, rational, logarithmic and exponential functions; systems of equations, progressions; sequences and series; matrices and determinants. Prerequisite: MATH 104, Intermediate Algebra, or equivalent as determined by MATH placement test.
ENGL 1301*	**Composition I** Students study the process of composing essays, including prewriting techniques, drafting, and revising and editing. Students write several multi-paragraph essays of various types, in both in-class and out-of-class settings. Students critically analyze sample student and professional essays. Prerequisite: ENGL 020, Writing Skills II, or equivalent as determined by the English placement test.
ENGL 134*	**Interpersonal Communication** Theories and exercises in verbal and nonverbal communication with focus on interpersonal relationships. Students will study internal and external factors that impact communication, communication clarification, and conflict resolution. Various presentations are required. Prerequisite: ENGL 1301, Composition I.
MATH 1316*	**Plane Trigonometry** Topics in trigonometric functions, right triangles, trigonometric identities, radian measure, graphs of periodic functions, and oblique triangles. Prerequisite: MATH 1314, College Algebra.
CNS 2060	**Application Software** This course includes introductory concepts combined with an emphasis on the more predominate computer software including, but not limited to DOS, word processing, electronic spreadsheets, and databases, thus providing non-majors with computer literacy and hands-on experience.

OSH 216	**Safety and Accident Prevention** A course designed to enable the student to recognize hazards and potential hazards which may occur in the workplace and to take corrective action. The course may be directed toward a specific technology as required. Federal safety requirements under the OSHA law will be emphasized. General supervisor safety training course for all technologies.
PHY 114	**Basic Fluid Power** A basic study of hydraulic system components, fluid power theory, problem solving and troubleshooting techniques. Prerequisite: MTH 109, Mathematics for Industrial Technicians, MTH 110, Basic Algebraic Concepts, or equivalent.
EST 120	**Electrical Applications** A survey course designed to present basic concepts in DC and AC circuits, fundamental motor design and applications, and basic motor controls.
WLT 105	**Survey of Welding Processes and Applications** This course is a survey of shielded metal arc, gas tungsten arc, gas metal arc, flux cored arc, and submerged arc welding processes. Metals weldability and weld symbols are considered. Process safety, electrode selection, and process parameters are emphasized. Hard surfacing using shielded metal arc and oxyacetylene processes and techniques are studied. It is recommended that the student have some knowledge of the welding processes before enrollment in this course.
DDT 128	**Introduction to Computer Drafting** This course introduces the student to Computer-Aided Drafting (CAD). This introduction involves equipment software and basic command logic. Graphic images are created using introductory level commands. Recommended for Non-Majors.
PSYC 2301*	**General Psychology** A survey of the major topics in psychology, introducing the study of behavior and the factors that determine and affect behavior.
PHYS 1310*	**Elementary Physics** An algebra-level problem-oriented course. Presents special topics in classical physics, such as basic mechanics, optics, acoustics, or electricity. Prerequisite: MATH 1314, College Algebra, or above.

* Course syllabi in Volume 2

THE MAST TECHNICAL WORKPLACE COMPETENCY/COURSE CROSSWALK

Upon development of appropriate curricula for the pilot programs, each MAST college began to develop individual course outlines for its assigned specialty area. The skill standards identified in the Competency Profile were cross walked against the technical competencies of the courses in the pilot curriculum. The resulting matrix provided a valuable tool for assessing whether current course content was sufficient or needed to be modified to ensure mastery of entry level technical competencies. Exit proficiency levels for each of the technical competencies were further validated through industry wide surveys both in Texas and across the nation.

The Technical Workplace Competency/Course Crosswalk in the following pages presents the match between industry-identified duties and tasks and the pilot curriculum for . Course titles are shown in columns, duties and tasks in rows. The Exit Level Proficiency Scale, an ascending scale with 5 the highest level of proficiency, includes marked boxes indicating whether the task is covered by the instructor during the course; the numbers 1-5 indicate the degree of attention given to the task and the corresponding proficiency expected on the part of the student. The crosswalk is intended to serve as an aide to other instructional designers and faculty in community college programs across the nation.

Included on the following pages is the Technical Workplace Competency/Course Crosswalk for the pilot program curriculum. This crosswalk validates the fact that the duties and tasks which were identified by industry as being necessary for entry level employees have been incorporated into the development of the course syllabi.

Technical Workplace Competencies/Course

CROSSWALK

TECHNICAL COMPETENCY: MANUFACTURING ENGINEERING TECHNOLOGY - COMPUTER AIDED MANUFACTURING OPTION

	Machine Tool Practices I	Drafting Principles	Machine Tool Practices II	Application Software	Engineering Materials	Safety/Accident Prevention	Basic Fluid Power	Electrical Applications	Survey Welding Applic./Proc.	CNC Machine Programming	Statics	Manufacturing Processes	Intro. to Computer Drafting	CAD/CAM I	Tool Design I	Strength of Materials	CAD/CAM II	Computer Integrated Mfg	QA/Statistical Process Ctrol		EXIT COMPETENCY LEVEL
A. PRACTICE SAFETY																					
A-1 Follow Safety and All Safety Regulations/Requirements	X		X			X		X	X	X		X			X						4
A-2 Use Protective Equipment	X		X			X		X	X	X		X			X						4
A-3 Follow Safe Operating Procedures for Hand and Machine Tools	X		X			X		X	X	X		X			X						4
A-4 Maintain a Clean and Safe Work Environment	X		X			X		X	X	X		X			X						4
A-5 Control Fire Hazards	X		X			X															4
A-6 Apply American Red Cross First Aid and CPR Procedures						X															2
A-7 Recommend Hazardous Waste Management Techniques						X															2
A-8 Apply Ergonomic Principles to the Workplace						X						X			X						2
A-9 Demonstrate Knowledge of State and Federal EPA Regulations						X															2
B. APPLY MATHEMATICAL CONCEPTS																					
B-1 Perform Basic Arithmetic Functions	X	X	X		X		X	X		X	X	X		X		X	X		X		4
B-2 Interconvert Fractions/Decimals	X	X	X		X					X	X	X		X		X	X		X		4
B-3 Interconvert Metric/English Measurements	X		X								X					X			X		3
B-4 Perform Basic Algebraic Operations											X					X			X		4
B-5 Perform Basic Trigonometric Functions		X								X	X					X					4
B-6 Calculate Speeds and Feeds for Machining	X		X							X		X		X	X		X				4
B-7 Locate Machining Points from a Datum Point	X		X							X	X	X	X	X	X		X	X			4
B-8 Perform Calculations for Sine Bar and Sine Plate			X																		2
B-9 Calculate for Direct, Simple, and Angular Indexing			X																		2
B-10 Perform Calculations Necessary for Turning Tapers			X																		2
B-11 Solve for Little "H"			X																		2
B-12 Use all Functions on a Scientific Calculator	X		X							X	X					X			X		3
B-13 Solve Engineering Equations											X					X			X		3
B-14 Solve Static Systems for Resultant Force											X					X					3
B-15 Determine Strength of Materials for Various Applications											X					X					3
C. INTERPRET ENGINEERING DRAWINGS AND CONTROL DOCUMENTS																					
C-1 Review Blueprint Notes and Dimensions	X	X	X						X	X		X		X	X		X		X		4
C-2 Identify Basic Layout of Drawings	X	X	X							X		X		X	X		X				4
C-3 Identify Basic Types of Drawings	X	X	X							X		X		X	X		X				4

Technical Workplace Competencies/Course

CROSSWALK

TECHNICAL COMPETENCY: MANUFACTURING ENGINEERING TECHNOLOGY - COMPUTER AIDED MANUFACTURING OPTION

	Machine Tool Practices I	Drafting Principles	Machine Tool Practices II	Application Software	Engineering Materials	Safety/Accident Prevention	Basic Fluid Power	Electrical Applications	Survey Welding Applic./Proc.	CNC Machine Programming	Statics	Manufacturing Processes	Intro. to Computer Drafting	CAD/CAM I	Tool Design I	Strength of Materials	CAD/CAM II	Computer Integrated Mfg	QA/Statistical Process Ctrol		PROFICIENCY
C-4 List the Purpose of Each Type of Drawing		X												X	X		X				4
C-5 Verify Drawing Elements	X	X	X							X			X	X	X		X	X			3
C-6 Practice Geometric Dimensioning and Tolerancing (GD&T) Methodology										X			X	X	X		X	X	X		3
C-7 Describe the Relationship of Engineering Drawings to Planning	X	X	X							X		X	X	X	X		X	X			3
C-8 Use Standards to Verify Requirements	X	X	X							X		X	X	X	X		X	X	X		4
C-9 Analyze Bill of Materials (BOM)	X	X	X							X		X	X	X	X		X	X	X		4
C-10 Understand and Use Quality Systems	X		X									X						X	X		3
D. RECOGNIZE DIFFERENT MANUFACTURING MATERIALS AND PROCESSES																					
D-1 Identify Materials With Desired Properties	X		X		X				X		X	X			X	X					3
D-2 Identify Materials and Processes to Produce a Product	X		X		X				X	X	X	X			X	X					3
D-3 Describe Heat Treating Processes					X							X									2
D-4 Perform Heat Treating Operations												X									1
D-5 Test Metal Samples for Hardness					X							X									2
D-6 Describe Casting Processes												X									2
D-7 Describe Hot Working Processes												X									2
D-8 Describe Cold Working Processes												X									2
D-9 Evaluate Alternative Manufacturing Processes					X							X									2
E. DEMONSTRATE MEASUREMENT/INSPECTION TECHNIQUES																					
E-1 Identify Types of Measurement Used in Manufacturing	X		X									X							X		3
E-2 Select Proper Measurement Tools	X		X									X							X		3
E-3 Apply Proper Measuring Techniques	X		X							X		X							X		3
E-4 Use Metric and English Standards of Measurement	X		X									X							X		3
E-5 Perform Measurements With Hand Held Instruments	X		X							X		X							X		3
E-6 Perform Measurements on Surface Plate	X		X							X		X							X		3
E-7 Perform Inspections Using Stationary Equipment												X							X		3
F. PERFORM CONVENTIONAL MACHINING OPERATIONS																					
F-1 Prepare and Plan for Machining Operations	X		X							X		X			X						3
F-2 Use Proper Hand Tools	X		X						X			X			X						4
F-3 Operate Power Saws	X		X									X			X						4
F-4 Operate Drill Presses	X		X									X			X						4

Technical Workplace Competencies/Course

CROSSWALK

TECHNICAL COMPETENCY: MANUFACTURING ENGINEERING TECHNOLOGY - COMPUTER AIDED MANUFACTURING OPTION

	Machine Tool Practices I	Drafting Principles	Machine Tool Practices II	Application Software	Engineering Materials	Safety/Accident Prevention	Basic Fluid Power	Electrical Applications	Survey Welding Applic./Proc.	CNC Machine Programming	Statics	Manufacturing Processes	Intro. to Computer Drafting	CAD/CAM I	Tool Design I	Strength of Materials	CAD/CAM II	Computer Integrated Mfg	QA/Statistical Process Ctrol		EXIT PROFICIENCY LEVEL
F-5 Operate Vertical Milling Machines	X		X									X			X						3
F-6 Operate Horizontal Milling Machines			X									X			X						3
F-7 Operate Metal Cutting Lathes	X		X									X			X						3
F-8 Operate Grinding/Abrasive Machines			X		X							X			X						2
G. PERFORM ADVANCED MACHINING PROCESSES																					
G-1 Prepare and Plan for CNC Machining Operations										X				X			X	X			3
G-2 Select and Use CNC Tooling Systems										X				X			X	X			3
G-3 Program CNC Machines										X				X			X	X			3
G-4 Operate CNC Machining Centers (Mills)										X				X			X	X			3
G-5 Operate CNC Turning Centers (Lathes)										X								X			2
G-6 Operate Electrical Discharge Machines																					
G-7 Download Programs Via Network										X				X			X	X			2
G-8 Program CNC Machines Using a CAM System														X			X	X			3
H. PERFORM GEAR GENERATING OPERATIONS																					
H-1 Describe the Different Types of Gears			X									X									2
H-2 Understand Gear Terms			X									X									2
H-3 Use Rotary Tables and Dividing Heads			X									X									2
H-4 Discuss Gear Inspection and Measurement			X									X									2
I. PERFORM WELDING OPERATIONS																					
I-1 Weld With Shielded Metal Arc Welding (SMAW) Process									X			X									2
I-2 Weld/Cut With Oxyacetylene									X			X									2
I-3 Weld With Gas Tungsten Arc Welding (GTAW) (Heliarc)									X												2
I-4 Weld With Gas Metal Arc Welding (GMAW)/(MIG) and Flux Core Arc Welding (FCAW)									X												2
I-5 Perform Plasma Arc Cutting (PAC)									X												2
J. PERFORM DRAFTING TASKS																					
J-1 Demonstrate Traditional Mechanical Drafting Skills		X																			3
J-2 Use Computer-Aided Drafting (CAD) System													X								3
J-3 Create 3-D Solid Models													X								2
J-4 Make Tool Drawings															X						2
K. USE COMPUTERS	X		X									X			X						4

Technical Workplace Comptencies/Course

CROSSWALK

TECHNICAL COMPETENCY: MANUFACTURING ENGINEERING TECHNOLOGY - COMPUTER AIDED MANUFACTURING OPTION

	Machine Tool Practices I	Drafting Principles	Machine Tool Practices II	Application Software	Engineering Materials	Safety/Accident Prevention	Basic Fluid Power	Electrical Applications	Survey Welding Applic./Proc.	CNC Machine Programming	Statics	Manufacturing Processes	Intro. to Computer Drafting	CAD/CAM I	Tool Design I	Strength of Materials	CAD/CAM II	Computer Integrated Mfg	QA/Statistical Process Ctrol		MAY PROFICIENCY LEVEL
K-1 Use Computer Operating Systems				X						X			X	X			X	X	X		4
K-2 Use Computer Inquiry Systems				X														X	X		
K-3 Use Various Computer Applications				X						X			X	X			X	X	X		3
K-4 Recommend and Implement CIM Technologies														X			X	X	X		
K-5 Use Computer-Aided Engineering System																					
L. PARTICIPATE IN TOTAL QUALITY AND SPC ACTIVITIES																					
L-1 Define Quality in Manufacturing and Explain Importance	X		X									X						X	X		
L-2 Implement Concepts of Quality in the Workplace												X						X	X		
L-3 Apply Principles and Tools of Continuous Quality Improvement																		X	X		
L-4 Understand and Apply SPC																			X		2
L-5 Evaluate Data to Monitor Production																		X	X		
L-6 Analyze Customer Problems and Recommend Solutions																		X	X		2
L-7 Establish Methods, Plans and Procedures to Maintain Quality																		X	X		
M. MAINTAIN ELECTRICAL DEVICES																					
M-1 Use Electrical Test Equipment								X										X			
M-2 Apply Specific Terms to Electrical Circuits								X										X			2
M-3 Analyze Series, Parallel and Complex DC/AC Circuits								X										X			
M-4 Check AC and DC Motors								X										X			2
M-5 Inspect Transformers and Generators								X													
M-6 Discuss Sensors and Feedback Technology								X										X			2
M-7 Set Up/Program PLC																		X			
M-8 Troubleshoot Electrical Devices								X										X			2
N. MAINTAIN HYDRAULIC/PNEUMATIC DEVICES																					
N-1 Use Test Equipment							X											X			
N-2 Describe Basic Principles of Hydraulic Systems							X														2
N-3 Identify Hydraulic Fluids							X														
N-4 Recommend Power Distribution and Sealing Devices							X														2
N-5 Recognize Pumps, Actuators, and Hydraulic Control Devices							X											X			
N-6 Troubleshoot Hydraulic/Pneumatic Systems							X											X			2

MANUFACTURING ENGINEERING TECHNICIAN
TECHNICAL WORKPLACE COMPETENCIES
EXIT LEVEL PROFICIENCY MATRIX

Manufacturing Engineering Technician: use special knowledge and skills to recommend and/or implement solutions for specific manufacturing applications.

The following matrix identifies the five exit levels of technical workplace competencies for the Machinist Certificate at Texas State Technical College Waco.

EXIT LEVEL OF PROFICIENCY					
Technical Workplace Competency	**1**	**2**	**3**	**4**	**5**
	rarely	routinely with supervision	routinely with limited supervision	routinely without supervision	initiates/ improves/ modifies and supervises others

THE MAST SCANS/COURSE CROSSWALK

The Secretary's Commission on Achieving Necessary Skills (SCANS), U. S. Department of Labor, has identified in its "AMERICA 2000 REPORT' the following five competencies and a three-part foundation of skills and personal qualities that are needed for solid job performance:

COMPETENCIES:

Resources:	Identifies, organizes, plans, and allocates resources
Interpersonal:	Works with others
Information:	Acquires and uses information
Systems:	Understands complex inter-relationships
Technology:	Works with a variety of technologies

FOUNDATION SKILLS:

Basic Skills:	Reads, writes, performs arithmetic and mathematical operations, listens and speaks
Thinking Skills:	Thinks creatively, makes decisions, solves problems, visualizes, knows how to learn and reasons
Personal Qualities:	Displays responsibility, self-esteem, sociability, self-management, and integrity and honesty

Recognizing the value of SCANS proficiencies to job performance, as well as the growing mandate in many states to include SCANS activities in course curricula, MAST asked survey respondents to review the SCANS skill sets in the context of the draft skill standards for each occupational specialty area. MAST also incorporated evaluation of SCANS competencies and foundation skills into its assessment of the pilot training curricula. The results were summarized in a crosswalk that allowed MAST staff to modify course content where needed to strengthen achievement of SCANS competencies.

The following pages present the SCANS/Course Crosswalk for the pilot curriculum in Courses are listed along the top and SCANS competencies and foundations are shown along the left side of the matrix. An exit level proficiency matrix for SCANS competencies and foundation skills is provided as well.

As "soft" skills, the SCANS competencies are inherently difficult to quantify. MAST realizes that some faculty will emphasize the SCANS more or less than others. The SCANS/Course Crosswalk matrix has been included with this course documentation to show the importance of these "soft skills" and the importance of their being addressed in the classroom (particularly in technical classes). In time, faculty will learn to make these types of SCANS activities an integral and important part of the teaching process.

Included on the following pages is the SCANS/Course Crosswalk for the pilot program curriculum. This crosswalk validates the fact that the "soft skills" (SCANS) which were identified by industry as being necessary for entry level employees have been incorporated into the development of the course syllabi. Also included is a matrix which defines the exit level of proficiency scale (1-5).

SCANS/Course

CROSSWALK

MANUFACTURING ENGINEERING TECHNICIAN
COMPUTER AIDED MANUFACTURING OPTION

COMPETENCY	Machine Tool Practices I	Drafting Principles	Machine Tool Practices II	Application Software	Engineering Materials	Safety/Accident Prevention	Basic Fluid Power	Electrical Applications	Survey Welding Applic./Proc.	CNC Machine Programming	Statics	Manufacturing Processes	Intro. to Computer Drafting	CAD/CAM I	Tool Design I	Strength of Materials	CAD/CAM II	Computer Integrated Mfg	QA/Statistical Process Ctrol		EVIT COMPETENCY TOTAL
(RS) RESOURCES:																					
A. Allocates time	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		4
B. Allocates money			X			X			X	X		X		X	X		X	X	X		3
C. Allocates material and facility resources	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		3
D. Allocates human resources	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		3
(IN) INTERPERSONAL SKILLS:																					
A. Participates as a member of a team	X		X		X	X	X	X		X	X	X		X	X	X	X	X	X		4
B. Teaches others	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		4
C. Serves clients/customers		X				X				X	X		X	X	X	X	X	X	X		3
D. Exercises leadership	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		4
E. Negotiates						X									X				X		2
F. Works with cultural diversity	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		4
(IF) INFORMATION SKILLS:																					
A. Acquires and evaluates information	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		4
B. Organizes and maintains information	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		4
C. Interprets and communicates information	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		4
D. Uses computers to process information				X			X			X			X	X	X		X	X	X		4
(SY) SYSTEMS:																					
A. Understands systems	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		4
B. Monitors and corrects performance	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		4
C. Improves and designs systems						X					X		X	X	X	X	X	X	X		3
(TE) TECHNOLOGY:																					
A. Selects technology	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		4
B. Applies technology to task	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		4
C. Maintains and troubleshoots technology	X		X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X		4

SCANS/Course

CROSSWALK

MANUFACTURING ENGINEERING TECHNICIAN COMPUTER AIDED MANUFACTURING OPTION

FOUNDATION SKILLS	Machine Tool Practices I	Drafting Principles	Machine Tool Practices II	Application Software	Engineering Materials	Safety/Accident Prevention	Basic Fluid Power	Electrical Applications	Survey Welding Applic./Proc.	CNC Machine Programming	Statics	Manufacturing Processes	Intro. to Computer Drafting	CAD/CAM I	Tool Design I	Strength of Materials	CAD/CAM II	Computer Integrated Mfg	QA/Statistical Process Ctrol		EXIT PROFICIENCY LEVEL
(BS) BASIC SKILLS:																					
A. Reading	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
B. Writing	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X		X	X		
C. Arithmetic and mathematics	X		X							X	X	X	X	X	X	X	X	X	X		
D. Listening	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
E. Speaking	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
(TS) THINKING SKILLS:																					
A. Creative thinking		X	X	X	X	X			X	X	X	X	X	X	X	X	X	X	X		
B. Decision making	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		4
C. Problem solving	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
D. Seeing things in the mind's eye	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		4
E. Knowing how to learn	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
F. Reasoning	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		4
(PQ) PERSONAL QUALITIES:																					
A. Responsibility	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
B. Self-esteem	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		4
C. Social	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
D. Self-management	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
E. Integrity/honesty	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		

SCANS
COMPETENCIES AND FOUNDATION SKILLS
EXIT LEVEL PROFICIENCY MATRIX

The Secretary's Commission on Achieving Necessary Skills (SCANS), U. S. Department of Labor, has identified in it's "AMERICA 2000 REPORT' the following five competencies and a three-part foundation of skills and personal qualities that are needed for solid job performance:

COMPETENCIES:

Resources:	Identifies, organizes, plans, and allocates resources
Interpersonal:	Works with others
Information:	Acquires and uses information
Systems:	Understands complex inter-relationships
Technology:	Works with a variety of technologies

FOUNDATION SKILLS:

Basic Skills:	Reads, writes, performs arithmetic and mathematical operations, listens and speaks
Thinking Skills:	Thinks creatively, makes decisions, solves problems, visualizes, knows how to learn and reasons
Personal Qualities:	Displays responsibility, self-esteem, sociability, self-management, and integrity and honesty.

The following matrix identifies the five exit levels of proficiency that are needed for solid job performance.

EXIT LEVEL OF PROFICIENCY					
SCANS Competencies and Foundation Skills	**1**	**2**	**3**	**4**	**5**
	rarely	routinely with supervision	routinely with limited supervision	routinely without supervision	initiates/ improves/ modifies and supervises others

MAST/01/013196

THE MAST COURSE SYLLABI
"PILOT PROGRAM"

MAST has produced a very unique set of course outlines, driven and validated by industry and encompassing the broad range of technologies covered by the MAST grant. The course outlines also include proposed SCANS activities that will be useful to an instructor in preparing students to enter the workforce of the future.

Included in the following pages are final course outlines developed and refined in the process of piloting the MAST training programs. The outlines include a brief course description; required course materials (e.g., textbook, lab manual, and tools, if available); proposed method of instruction; proposed lecture and lab outlines; and detailed course objectives for both Technical Workplace Competencies and SCANS Competencies.

These outlines were completed and revised during the second year of MAST, following completion of the pilot phase. The outlines are intended to serve as an aide to other instructional designers and faculty in community college programs across the nation.

Included on the following pages are the Course Syllabi for each of the courses which were taught during the pilot program.

***M**achine Tool **A**dvanced **S**kills*
***T**echnology Program*

MAST

COURSE SYLLABUS

MACHINE TOOL PRACTICES I

MAST PROGRAM
COURSE SYLLABUS
MACHINE TOOL PRACTICES I

Lecture hours/week: 3 **Lab hours/week: 9** **Credit hours: 6**

COURSE DESCRIPTION:

Students will be assigned specifically designed projects that will be machined using the engine lathe, milling machine, drill press, and various saws. The capability and safe use of machine tools will be stressed.

PREREQUISITES: **NONE**

REQUIRED COURSE MATERIALS:

Textbook: Machine Tool Practices, Kibbe, Neely, and Meyer, Wiley Pub., 4th Ed.
Lab Manual: Machine Tool Practices I, Raborn, TSTC Pub., 4th Ed.

Student Tool List	Qty. Req'd.
Tool Box	1
Safety Glasses	1 pair
6 inch Ruler	1/8, 1/16, 1/32, and 1/64 inch
Ball Peen Hammer	1
10 inch Adjustable Wrench	1
Center Punch	1
Magic marker, Jumbo, black.	1
Aluminum Oxide Cloth, 9" X 11", 240 Grit	2 sheets
Aluminum Oxide Cloth, 9" X 11", 320 Grit	2 sheets
Tool Steel, 3/8", H.S.S.	2
Flat Mill Bastard File, 10 inch.	1
File Handle	1
Allen Wrench Set, Long English and Metric	1 each
Center Drill #3	1
Scribe	1
Center Gage	1
Screw Driver, 8 inch	1
File Card Brush	1
0-6 inch Dial Calipers	1
Shop Apron (blue denim)	1
Shop Towels (1 roll)	1

METHODS OF INSTRUCTION:

Lecture: Didactic presentations will include lecture, video and demonstrations.

Laboratory: Laboratory will be a "hands-on" machining process

Method of Evaluation: A student's grade will be based on multiple measures of performance. The assessment will measure development of independent critical thinking skills and will include evaluation of the student's ability to:

1. perform the manipulative skills of the craft as required to satisfactorily complete laboratory assignments
2. apply theory to laboratory assignments
3. satisfactorily perform on written, oral, and practical examinations
4. satisfactorily perform on outside assignments including writing assignments and oral presentations
5. contribute to class discussions
6. maintain attendance per current policy
7. follow all shop rules and safety regulations as stated in the laboratory manual

LECTURE OUTLINE:

Lecture Topics	Text Reference Page	Contact Hrs.
Introduction to the Course	---	1
Safety	5-12	1
Tool Grinding	43-45 (lab book)	1
The Machine Shop	1-4	1
The Inch Rule	113-118	1
The Square	163-166	1
The Inch Micrometer	140-145	1
Drawings	28-36	2
Layout Tools	249-262	2
QUIZ I (over above lectures)	---	1
Semi-precision Layout	262-266	1
Hand Tools	46-55	1
Hacksaws	55-58	1
Files	58-63	1
Verniers	122-125	1
Vernier Micrometers	151-156	1
The Drill Press	365-374	1
Drilling Tools	375-384	2
QUIZ 2 (over above lectures)	---	1
Drilling Operations	389-402	2
Taps	68-74	1
Tapping Procedures	74-79	1
Gage Blocks	178-187	1
Angular Measuring	187-195	1

Precision Layout	267-280	2
QUIZ 3 (over above lectures)	---	1
Oral Presentations*	---	5
	Total Lecture Hours	**36**

**(10-15 minute student presentations on assigned machine-related topics. These topics could include future trends or special concerns of the machine tool industry.)*

LAB OUTLINE:

Lab Topics	Contact Hrs.
Shop orientation	2
Use of the cut-off saw	2
Grinding a lathe tool	3
Grinding a mill tool	3
Using the band saw	3
Using the radial drill	3
Using the sensitive drill	3
Bench work	27
Lathe work	27
Mill work	27
Leaving the shop in order	3
Inspecting the finished work	5
Total Lab Hours	**108**

COURSE OBJECTIVES: TECHNICAL COMPETENCIES

After the successful completion of this course the student will be able to:

A. PRACTICE SAFETY

1. Follow Safety Manuals and All Safety Regulations/Requirements
   a. Assume responsibility for the personal safety of oneself and others
   b. Develop a personal attitude towards safety
   c. Comply with established safety practices
2. Use Protective Equipment
   a. Wear protective safety clothing as required
   b. Maintain and use protective guards and equipment on machinery
   c. Locate and properly use protective equipment
   d. Use lifting aids when necessary
3. Follow Safe Operating Procedures for Hand and Machine Tools
   a. Understand and apply safe machine operating procedures
   b. Demonstrate safe machine operation
4. Maintain a Clean and Safe Work Environment
   a. Keep work areas clean
   b. Clean machine/hand tools when work is completed
   c. Put tools away when work is finished

d. Keep aisles clear of equipment and materials

B. APPLY MATHEMATICAL CONCEPTS

1. Calculate Speeds and Feeds for Machining
   a. Calculate RPM for various metals and various tools
   b. Calculate feed for various metals, tools, and depths of cut

C. INTERPRET ENGINEERING DRAWINGS AND CONTROL DOCUMENTS

1. Review Blueprint Notes and Dimensions
   a. Explain basic blueprint terminology
   b. Identify the types of dimensions
   c. Identify general note symbols
   d. Locate notes on a print
   e. Interpret commonly used abbreviations and terminology
   f. Determine tolerances associated with dimensions on a drawing
   g. Determine the tolerance for a reference dimension
2. Identify Basic Layout of Drawings
   a. Identify types of lines within a drawing
   b. Identify general note symbols
3. Identify Basic Types of Drawings
   a. Identify orthographic views
   b. Identify positions of views (top, front, side, and auxiliary)
   c. Visualize one or more views from a given view
4. List the Purpose of Each Type of Drawing
   a. Identify the purpose of orthographic (3 views) drawings

D. PERFORM MEASUREMENT/INSPECTION

1. Identify Types of Measurement
   a. Discuss the use of metrology in manufacturing
   b. Discuss the inch system of measurement
   c. Discuss the metric system of measurement
   d. Discuss semi-precision and precision measurement
   e. Discuss the following: accuracy, precision, reliability, and discrimination
2. Select Proper Measurement Tools
   a. Identify basic semi-precision measuring tools
   b. Identify precision measuring tools
   c. Justify the use of a particular measuring tool based on tool characteristics
   d. Identify error possibilities in measurement tool selection
   e. Demonstrate proper care of precision measuring tools
3. Apply Proper Measuring Techniques
   a. Discuss factors affecting accurate measurement (dirt, temperature, improper measuring tool calibration)
   b. Explain calibration requirements of various precision instruments
   c. Illustrate measurement differences when taken with calibrated and non-calibrated instruments
   d. Calibrate a micrometer type measuring tool
4. Perform Measurements With Hand Held Instruments
   a. Measure with steel rules (metric and inch)
   b. Measure with micrometers

c. Measure with comparison measuring instruments (e.g., calipers, telescope gages)
d. Measure with direct measuring instruments (e.g., vernier, dial, and digital instruments)
e. Measure with fixed gages (go and not go gages)

5. Perform Measurements on Surface Plate
   a. Describe care of surface plate
   b. Use surface plate accessories correctly (sine bar, gage blocks, etc.)
   c. Check for part squareness
   d. Check part dimensions for accuracy
   e. Align workpieces using height gage and dial indicators

E. PERFORM CONVENTIONAL MACHINING OPERATIONS

1. Prepare and Plan For Machining Operations
   a. Read and interpret blueprints
   b. Perform basic semi-precision and precision layout as necessary
   c. Plan machining operations
   d. Calculate speeds, feeds, and depth of cut for various machine applications
   e. Use carbides and other tool materials to increase productivity
2. Use Proper Hand Tools
   a. Use arbor and shop presses
   b. Select necessary work-holding devices and hand tools as needed
   c. Select and use hand files
   d. Identify and use hand reamers
   e. Correctly identify and use hand taps as required
   f. Follow tapping procedures to produce internal threads
   g. Use thread-cutting dies to produce external threads
   h. Operate bench and pedestal grinders safely
3. Operate Power Saws
   a. Use reciprocating and horizontal band cutoff machines
   b. Prepare and use the vertical band saw
4. Operate Drill Presses
   a. Describe the different types of drill presses found in the machine shop
   b. Describe and use standard drilling tools
   c. Setup the drill presses for drilling, countersinking, counterboring, and reaming operations
5. Operate Vertical Milling Machines
   a. Demonstrate the use of all controls on the vertical milling machine
   b. Align the vertical milling machine head
   c. Select, align and use workholding devices
   d. Select milling tool holders
   e. Select milling cutters
   f. Perform all standard vertical milling operations
6. Operate Metal Cutting Lathes
   a. Demonstrate the use of all controls on the engine lathe
   b. Discuss standard tools and toolholders for the lathe
   c. Face and center drill parts correctly

d. Drill, ream and bore on the lathe
e. Make all calculations, lathe adjustments and settings to machine sixty degree external threads
f. Use HSS cutting tools
g. Use carbide cutting tools

COURSE OBJECTIVES: SCANS COMPETENCIES

The Secretary's Commission on Achieving Necessary Skills (SCANS), U.S. Department of Labor, has identified in its "AMERICA 2000 REPORT" that all students should develop a new set of competencies and foundation skills if they are to enjoy a productive, full and satisfying life. These are in addition to the Technical Workplace Competencies required by industry. SCANS is made up of five competencies and a three-part foundation of skills and personal qualities that are needed for solid job performance.

The following activities will be performed by each student for successful completion of this course:

I. COMPETENCIES

A. Resources: Identifies, organizes, plans, and allocates resources
1. follows a schedule to complete assigned tasks on time
2. follows a schedule to maximize laboratory resources
3. complete a stock request form for required material

B. Interpersonal: Works with others
1. complete assigned responsibilities within the shop floor serving as a member of the team
2. provide individual assistance/direction to peers as requested

C. Information: Acquires and uses information
1. read and interpret blueprints
2. organize and apply theories of machine tool operation
3. perform basic semi-precision and precision layout as necessary

D. Systems: Understands complex inter-relationships
1. demonstrate knowledge of the following systems:
   a. organization of personnel and facilities on the shop floor
   b. systematic approach to the metal removal process
   c. dimensioning and measurement systems
2. monitors and corrects performance during
   a. the machining process
   b. adjustments of individual laboratory work schedule
   c. constantly evaluating the quality of work to achieve acceptable standards

E. Technology: Works with a variety of technologies
1. chooses procedure, tools and equipment required to produce a part

2. applies appropriate procedures and uses appropriate tools and equipment to produce a machined part to acceptable standards

II. FOUNDATION SKILLS

A. ***Basic Skills:*** *Reads, writes, performs arithmetic and mathematical operations, listens and speaks.*

1. ***Reading:*** *Locates, understands, and interprets written information in prose and in documents such as manuals, graphs, and schedules*

a. read/studies textbook
b. studies student laboratory manual
c. interprets blueprints and technical drawings
d. follow a daily laboratory schedule to maintain appropriate time-line and product completion

2. ***Writing:*** *Communicates thoughts, ideas, information, and messages in writing; and creates documents such as letters, directions, manuals, reports, graphs, and flow charts*

a. outline the steps necessary to produce a simple machine part
b. maintain a lecture notebook
c. submit written responses to chapter question assignments

3. ***Arithmetic/Mathematics:*** *Perform basic computations and approaches practical problems by choosing appropriately from a variety of mathematical techniques*

a. determines optimum machining speeds, feeds, and depth of cut
b. interconverts fractions to decimal expressions
c. keeps a running computation of individual grade
d. calculate tap drill size

4. ***Listening:*** *Receives, attends to, interprets, and responds to verbal messages and other cues*

a. assimilate classroom instruction
b. interpret and assimilate video instruction
c. observe and assimilate laboratory demonstrations
d. seek and receive individualized instruction in the laboratory
e. practices active listening by affirming understanding of verbal instructions, asking questions for clarification and probing for specifics

5. ***Speaking:*** *Organizes ideas and communicates orally*

a. participates in classroom discussions
b. organize ideas and communicate specific questions to the instructor
c. verbally affirms understanding of a concept, procedure, or required skill
d. communicate with peers, instructors and supervisors to ensure the smooth and safe operation of the laboratory
e. plan and deliver a 10-15 minute oral presentation on an assigned machine-related topic

B. ***Thinking Skills:*** *Thinks creatively, makes decisions, solves problems, visualizes, knows how to learn and reasons.*

1. ***Decision Making:*** *Specifies goals and constraints, generates alternatives, considers risks, and evaluates and chooses best alternative*
   a. decides upon a job process plan to produce a part to specifications, given constraints of available time, equipment and other resources
   b. prioritizes activities for effective use of time
2. ***Problem Solving:*** *Recognizes problems and devises and implements plan of action*
   a. makes daily accommodations to stay on schedule
   b. seeks additional instruction/clarification for assignment completion
   c. troubleshoots machining processes and equipment
   d. recognize problems in machining and selects appropriate corrective or preventive action
3. ***Seeing Things In the Mind's Eye:*** *Organizes, and processes symbols, pictures, graphs, objects, and other information*
   a. visualize objects in three dimensions from engineering drawings
   b. visualize process during instructor lecture
   c. visualize the relative motions between tool and workpiece to generate desired features in raw stock in order to plan machine setups and sequence of machining operations
4. ***Knowing How to Learn:*** *Use efficient learning techniques to acquire and apply new knowledge and skills*
   a. understand that practice will improve skill
   b. asks questions or seeks help when uncertain about new skills or knowledge
5. ***Reasoning:*** *Discovers a rule or principle underlying the relationship between two or more objects and applies it when solving a problem*
   a. applies knowledge of principles of machining to troubleshoot process problems
   b. applies knowledge of machining process to develop a logical, sequential process plan
   c. applies knowledge of workpiece machinability, cutter characteristics and machine tool characteristics to adjust speeds and feeds

C. ***Personal Qualities:*** *Displays responsibility, self-esteem, sociability, self-management, and integrity and honesty.*
1. ***Responsibility:*** *Exerts a high level of effort and perseveres towards goal attainment*
   a. displays promptness and preparation for the day's work
   b. plans work to use time efficiently
   c. accepts responsibility for mistakes, and takes corrective and preventive actions
   d. takes initiative when needed to gain resources or assistance to complete assignments
2. ***Self-Esteem:*** *Believes in own self-worth and maintains a positive view of self*
   a. takes pride in work through positive reinforcement

b. sees self as a valued member of the group through continued contributions toward common goals

3. ***Sociability:*** *Demonstrates understanding, friendliness, adaptability, empathy, and politeness in group settings*
   a. assist classmates in improving technical skills
   b. share laboratory resources (machines, tools and instructor's individual attention)
4. ***Self-Management:*** *Assesses self accurately, sets personal goals, monitors progress, and exhibits self-control*
   a. perform in-process quality checks on machined parts
   b. maintain a record of academic achievement (individual gradebook)
   c. accept responsibility for mistakes and infractions, and take steps to resolve or eliminate them
5. ***Integrity/Honesty:*** *Chooses ethical courses of action*
   a. accept the responsibility for own actions
   b. exhibit personal honesty at all times
   c. accept the challenge of doing your own work in the laboratory, during examination, and on outside assignments
   d. understand the consequences of unethical behaviors

Appropriate Reference Materials:

1. Machinery's Handbook, Industrial Press
2. Technology of Machine Tools, 4th Ed. McGraw Hill Publishers

MET100
01/072296

***M*achine Tool *A*dvanced *S*kills**
***T*echnology Program**

MAST

COURSE SYLLABUS

DRAFTING PRINCIPLES

MAST PROGRAM
COURSE SYLLABUS
DRAFTING PRINCIPLES

Lecture hours/week: 2 **Lab hours/week: 4** **Credit hours: 3**

COURSE DESCRIPTION:

Students will be assigned basic exercises in lettering, use of instruments, technical sketching, geometric construction, orthographic projection, auxiliary views and dimensioning. Working drawings will be made.

PREREQUISITES: **NONE**

REQUIRED COURSE MATERIALS:

Textbook: **Technical Drawing,** Spencer, Giesecke, Mitchell, Hill
Workbook: **Technical Drawing Problems,** Spencer, Giesecke, Mitchell, Hill

Materials:
Drafting Kit No. 1 or the equivalent:

- 10" Triangles:
  - 1 - 45°
  - 1- 30°/60°
- Engineer's Scale
- Metric Scale
- Ames Lettering Guide
- Eraser Holder with erasers
- Drafting Dots
- Circle Template (Combination Imperial and Metric)
- Sandpaper Pointer
- Erasing Shield
- Bow Compass
- Dusting Brush
- Lead Pointer
- Irregular Curve
- Mechanical Pencils with refills:
  - .5mm
  - .7mm
  - .9mm
- Lead Holder - 2mm
- Leads:
  - .5mm - HB
  - .7mm - H, HB
  - .9mm - HB

2mm 4H, H, F
Hard Carrying Case
8½" x 11" vellum (10 sheets)

Additional items not included in kit:
4 - 17 x 22 (C size) vellum
1 - Preprinted 22 x 34 (D size) vellum

METHODS OF INSTRUCTION:

Lecture: Classroom presentations will include lecture, video and demonstrations. Computer aided instruction may be used.

Laboratory: Laboratory will be a "hands-on" drawing process using appropriate tools and media.

Method of Evaluation: A student's grade will be based on multiple measures of performance. The assessment will measure development of independent critical thinking skills and will include evaluation of the student's ability to:

1. perform the manipulative skills of the craft as required to satisfactorily complete laboratory assignments
2. apply theory to laboratory assignments
3. satisfactorily perform on written, oral, and practical examinations
4. satisfactorily perform on outside assignments including writing assignments
5. contribute to class discussions
6. maintain attendance per current policy
7. follow all safety regulations as stated in the class policies

LECTURE OUTLINE:

Lecture Topics	Text Reference Page	Contact Hrs.
Introduction to Course	---	
Required Materiáls and Tests	Handout	
Class Policies and Safety Concerns	Handout	
Function of Drafting in Design and Production	1	
Drafting Instruments, Material and Equipment	2	
Lettering	3	
Quiz	---	
Alphabet of Lines	2	
Types of Pencils and Leads	1	
Scales - Engineering and Metric	2	
Quiz	---	
Geometric Constructions	4	
Angle Measurements	4	
Theory of Third Angle Orthographic Projection	6	
Theory of First Angle Orthographic		

Projection	6
Arrangement of Views	6
Common Dimensions Between Views	6/11
Quiz	---
Function of Sectional Views	7
Cutting Planes	7
Conventional Representations	7
Classifications of Sections	7
Quiz	---
Dimensioning Concepts	11
Dimensioning Techniques	11
Selection and Placement of Dimensions	11
Metric Dimensioning	11
Final Exam	---
Total Lecture Hours	**24**

LAB OUTLINE:

Lab Topics	Contact Hrs.
Using Drafting Instruments, Materials and Equipment	2
Applying Lettering	2
Delineating Alphabet of Lines	2
Selecting and Using Pencils and Leads	1
Using Scales	2
Developing Geometric Constructions	12
Using Angle Measurement	1
Using Third Angle Orthographic Projection	6
Using First Angle Orthographic Projection	6
Arranging Views and Common Dimensions	2
Creating Sectional Planes	2
Applying Cutting Planes	2
Determine and Use Conventional Representations	1
Using Classifications of Sections	1
Applying Dimensioning	4
Applying Metric Dimensioning	1
Final Exam	1
Total Lab Hours	**48**

COURSE OBJECTIVES: TECHNICAL COMPETENCIES

After the successful completion of this course the student will be able to:

A. **PERFORM DRAFTING TASKS.**

1. Demonstrate Traditional Mechanical Drafting Skills
   a. Form freehand vertical Gothic upper-case letters and numerals of correct shape and space
   b. Execute the alphabet of lines correctly, producing dense black lines of uniform thickness and spacing
   c. Demonstrate proficiency with the engineers and metric scales

d. Execute geometric constructions with no mistakes in tangent points, line quality or layout work
e. Accurately draw the missing view or line in a multiview drawing
f. Make or complete a sectional instrument drawing, given one or more views
g. Develop satisfactory working drawings of simple machine components to include all necessary views and dimensions for complete shape and size description of detail parts
h. Discuss the differences in standard engineering drawings and tool drawings

COURSE OBJECTIVES: SCANS COMPETENCIES

The Secretary's Commission on Achieving Necessary Skills (SCANS), U.S. Department of Labor, has identified in its "AMERICA 2000 REPORT" that all students should develop a new set of competencies and foundation skills if they are to enjoy a productive, full and satisfying life. These are in addition to the Technical Workplace Competencies required by industry. SCANS is made up of five competencies and a three-part foundation of skills and personal qualities that are needed for solid job performance.

The following activities will be performed by each student for successful completion of this course:

I. COMPETENCIES

A. Resources: Identifies, organizes, plans, and allocates resources
1. follows a schedule to complete assigned tasks on time
2. determine the appropriate media and instruments to complete assignments
3. provide a self-evaluation of performance based on the time and quality of work

B. Interpersonal: Works with others
1. complete assigned responsibilities within the course serving as a member of the team
2. provide individual assistance/direction to peers as requested
3. produce drawings to acceptable levels of quality as required
4. works well with all members of the class

C. Information: Acquires and uses information
1. read and interpret text and handouts
2. organize and apply theories of drafting and design
3. apply lecture concepts to lab techniques

D. Systems: Understands complex inter-relationships
1. demonstrate knowledge of the following systems:
   a. laboratory organization structure: physical and social
   b. organization of personnel and facilities in the drafting lab
   c. systematic approach to the drafting and design process
   d. dimensioning and measurement systems
   e. systematic organization of training materials
2. monitors and corrects performance
   a. during the drawing process
   b. making adjustments to individual laboratory work schedules

c. while constantly evaluating the quality of work to achieve acceptable standards
d. though maintaining a record of evaluations
e. to meet individual goals

E. Technology: Works with a variety of technologies

1. chooses procedure, tools and equipment required to produce a drawing
2. applies appropriate procedures and uses appropriate tools and equipment to produce a drawing to acceptable standards
3. maintains and troubleshoots equipment and tools
   a. applies appropriate preventative maintenance
   b. reports all malfunctions of equipment to supervisor/instructor
   c. performs clean-up assignments of lab

II. FOUNDATION SKILLS

A. Basic Skills: Reads, writes, performs arithmetic and mathematical operations, listens and speaks.

1. Reading: Locates, understands, and interprets written information in prose and in documents such as manuals, graphs, and schedules
   a. studies student laboratory manual and text
   b. interprets blueprints and technical drawings
   c. reads/studies concepts in textbook
   d. follows a daily laboratory schedule to maintain appropriate time-line to meet scheduled deadlines
   e. interprets concepts in lab manual drawings and texts to develop accurate drawings

2. Writing: Communicates thoughts, ideas, information, and messages in writing; and creates documents such as letters, directions, manuals, reports, graphs, and flow charts
   a. outlines the steps necessary to produce a simple drawing
   b. sketches object to produce a final drawing
   c. maintains a schedule of assignments and deadlines (these may take the form of a chart, graph, etc.)
   d. maintains a lecture notebook
   e. submits written responses to chapter question assignments
   f. completes all written assignments

3. Arithmetic/Mathematics: Perform basic computations and approaches practical problems by choosing appropriately from a variety of mathematical techniques
   a. bisects lines, circles, arcs and angles
   b. divides objects into equal parts
   c. applies tolerances
   d. applies and verify dimensions
   e. uses fraction and decimal values
   f. applies principles of trigonometry and geometry to solve angle calculations, tangencies and to define points

4. Listening: Receives, attends to, interprets, and responds to verbal messages and other cues

a. assimilates concepts presented by lecture, video or any multimedia methods
b. observes laboratory demonstrations for technique and safety instructions
c. seeks and receive individualized instruction in the laboratory
d. actively listens and participates in discussions and question/answer sessions

5. ***Speaking:*** *Organizes ideas and communicates orally*
   a. participates in classroom discussions
   b. organizes ideas and communicates specific questions to the instructor
   c. verbally affirms understanding of a concept, procedure, or required skill
   d. communicates with peers to ensure the efficient and safe completion of assignments

B. ***Thinking Skills:*** *Thinks creatively, makes decisions, solves problems, visualizes, knows how to learn and reason.*

1. ***Decision Making:*** *Specifies goals and constraints, generates alternatives, considers risks, and evaluates and chooses best alternative*
   a. identifies personal goals
   b. prioritizes goals
   c. identifies specific actions required to accomplish personal goals
   d. allows for flexibility in meeting goals as circumstances change

2. ***Problem Solving:*** *Recognizes problems and devises and implements plan of action*
   a. makes daily accommodations to stay on schedule
   b. seeks additional instruction/clarification for assignment completion
   c. balances social and academic life/responsibilities
   d. accepts responsibility

3. ***Seeing Things In the Mind's Eye:*** *Organizes, and processes symbols, pictures, graphs, objects, and other information*
   a. understands both written and verbal instructions
   b. assimilates process during instructor demonstrations
   c. interprets technical drawings
   d. interprets technical illustrations and symbols
   e. interprets and applies geometric construction concepts
   f. completes missing orthographic views
   g. creates multiview projections from pictorial drawings
   h. identifies missing lines in multiview drawings

4. ***Knowing How to Learn:*** *Use efficient learning techniques to acquire and apply new knowledge and skills*
   a. demonstrates mastery of the basic skills and techniques
   b. uses these sequential skills to support mastery of new skills
   c. consistently applies the sequential nature of acquired skills to the subsequent knowledge application of new skills and techniques

5. ***Reasoning:*** *Discovers a rule or principle underlying the relationship between two or more objects and applies it when solving a problem*
   a. understands that practice will improve the skill of the technician

b. understands that the quality of the product is a function of time spent and the attitude and skill of the technician

C. ***Personal Qualities:*** *Displays responsibility, self-esteem, sociability, self-management, and integrity and honesty.*

1. ***Responsibility:*** *Exerts a high level of effort and perseveres towards goal attainment*
   a. attends class as scheduled and is well prepared for the day's work
   b. completes assignments independently and on time
   c. works well within a team while completing individual assignments
   d. plans and organizes so time may be used wisely
2. ***Self-Esteem:*** *Believes in own self-worth and maintains a positive view of self*
   a. learns to take pride in his or her work through positive reinforcement
   b. sees himself or herself as an asset to the class through continued contributions to the group and a shared common goal
   c. understands that an individual with a positive attitude and the belief in their own abilities will systematically seek solutions and be a valuable employee
3. ***Sociability:*** *Demonstrates understanding, friendliness, adaptability, empathy, and politeness in group settings*
   a. assists classmates in improving technical skills
   b. assists students with special needs as a peer mentor
   c. shares laboratory resources (machines, tools and instructor's individual attention)
4. ***Self-Management:*** *Assesses self accurately, sets personal goals, monitors progress, and exhibits self-control*
   a. performs in-process quality checks on technical drawings
   b. maintains a record of academic achievement (individual gradebook)
   c. maintains a schedule of deadlines, due dates, and other important dates (calendar)
   d. adjusts calendar to accommodate unexpected circumstances
   e. accepts the responsibility for self management
5. ***Integrity/Honesty:*** *Chooses ethical courses of action*
   a. accepts the responsibility for own actions
   b. exhibits personal honesty at all times
   c. accepts the challenge of doing your own work in the laboratory, during examination, and on outside assignments
   d. understands the consequences of unethical behaviors

*M*achine Tool *A*dvanced *S*kills
*T*echnology Program

MAST

COURSE SYLLABUS

MACHINE TOOL PRACTICES II

Prerequisite: MACHINE TOOL PRACTICES I

MAST PROGRAM
COURSE SYLLABUS
MACHINE TOOL PRACTICES II

Lecture hours/week: 3 **Lab hours/week: 9** **Credit hours: 6**

COURSE DESCRIPTION:

This course is designed to develop additional machining skills for those students who have the basic skills that were developed in Machine Tool Practices I.

The student will work from more complex engineering drawings and use the engine lathe and milling machines to produce parts that will assemble into a functioning machine. Precision work and the control of surface finishes will be stressed. The engine lathe will be used to turn, taper, thread, bore, ream and knurl several parts. The milling machine will be used to cut keyways, mill precise angles and bore holes. The safe operation and maintenance of the machine shop will also be an important objective.

PREREQUISITES: Machine Tool Practices I

REQUIRED COURSE MATERIALS:

Textbook: Machine Tool Practices, Kibbe, Neely, and Meyer, Wiley Pub., 4th Ed.
Lab Manual: Machine Tool Practices II, Raborn, TSTC Pub., 4th Ed.

Student Tool List/Qty. Req'd: The same hand tools required in Machine Tool Practices I are also required for Machine Tool Practices II.

METHODS OF INSTRUCTION:

Lecture: Didactic presentations will include lecture, video and demonstrations.

Laboratory: Laboratory will be a "hands-on" machining process.

Method of Evaluation: A student's grade will be based on multiple measures of performance. The assessment will measure development of independent critical thinking skills and will include evaluation of the student's ability to:

1. perform the manipulative skills of the craft as required to satisfactorily complete laboratory assignments
2. apply theory to laboratory assignments
3. perform on written, oral, or practical examinations
4. perform on outside assignments including writing assignments

5. contribute to class discussions
6. maintain attendance per current policy
7. follow all shop rules and safety regulations as stated in the laboratory manual

LECTURE OUTLINE:

Lecture Topics	Text Reference Page	Contact Hrs.
Introduction to the Course	---	1
Safety in the Machine Shop	5	1
Gages	88	1
Lathe Parts	414	1
Lathe Accessories	394	1
Cutting Speeds and Feeds	270	1
Aligning Centers	440	1
Machining Between Centers	428	1
Knurling and Grooving	452	1
QUIZ I (over the above units)	---	1
Tapers	477	2
Threads	457	3
Using Chucks	408	1
Drilling and Boring	443	1
Milling Machines	502	1
QUIZ 2 (over the above units)	---	1
Milling Cutters	507	1
Cutting Speeds	522	1
Milling Operations	526	1
Indexing	592	2
Gears	607	1
Gear Cutting	611	1
Assembly of Jig Saw	---	3
QUIZ 3 (over the above units)	---	1
Oral Presentations*	---	6
	Total Lecture Hours	**36**

**(15-20 minute student presentations on assigned machine-related topics. These topics could include future trends or special concerns of the machine tool industry.)*

LAB OUTLINE:

Lab Topics	Contact Hrs.
Shop orientation and safety	1
Precision layout	4
Precision measuring with gage blocks and sine bar	8
Lathe work	27
Vertical milling machine work	18
Horizontal milling machine	6

Bench work	27
Assembly of machined parts	6
Testing of completed machine	6
Leaving the shop in order	5
Total Lab Hours	**108**

COURSE OBJECTIVES: TECHNICAL COMPETENCIES

After the successful completion of this course the student will be able to:

A. PRACTICE SAFETY

1. Follow Safe Operating Procedures for Hand and Machine Tools
   a. Identify and understand lathe operating procedures
   b. Demonstrate safe lathe operation
   c. Identify and understand milling machine operating procedures
   d. Demonstrate safe milling machine operation

B. APPLY MATHEMATICAL CONCEPTS

1. Perform Basic Trigonometric Functions
   a. Solve for unknown angles
   b. Calculate bolt hole patterns
2. Calculate Speeds and Feeds for Machining
   a. Calculate RPM for various metals and various tools
   b. Calculate feed for various metals, tools, and depths of cut
3. Locate Machining Points from a Datum Point
   a. Identify points using the absolute dimensioning system
   b. Identify points using the incremental dimensioning system
4. Perform Calculations for Sine Bar and Sine Plate
   a. Calculate gage block build up for 5" sine bar
5. Calculate for Direct, Simple, and Angular Indexing
   a. Calculate for direct indexing
   b. Calculate for simple indexing (plain)
   c. Calculate for angular indexing
   d. Use Machinery's Handbook for calculations
6. Perform Calculations Necessary for Turning Tapers
   a. Calculate tail stock offset
   b. Determine unknowns (e.g., small and/or large diameters) for taper turning
7. Calculate Depth of Cut on Round Surfaces
   a. Calculate depth of cut for flats to be machined on cylindrical pieces
   b. Calculate depth of cut for keyways which are machined on cylindrical pieces

C. PERFORM CONVENTIONAL MACHINING OPERATIONS

1. Operate Vertical Milling Machines
   a. Demonstrate the use of all controls on the vertical milling machine
   b. Align the vertical milling machine head
   c. Select, align and use workholding devices
   d. Select milling tool holders

e. Select milling cutters
f. Perform all standard vertical milling operations
g. Bore a hole using the offset boring head
h. Machine angles using sine bar and gage blocks
i. Setup and use special vertical mill fixtures
j. Setup and machine dovetails
k. Machine keyways

2. Operate Horizontal Milling Machines
   a. Discuss the difference in plain and universal horizontal milling machines
   b. Discuss the types of spindles, arbors and adaptors used on the horizontal milling machine
   c. List several common work holding methods
   d. Use plain milling cutters
   e. Use side milling cutters
   f. Use face milling cutters

3. Operate Metal Cutting Lathes
   a. Demonstrate the use of all controls on the engine lathe
   b. Discuss standard tools and toolholders for the lathe
   c. Face and center drill parts correctly
   d. Drill, ream and bore on the lathe
   e. Turn between centers
   f. Discuss alignment of lathe centers
   g. Make all calculations, lathe adjustments and settings to machine UNF and UNC series threads
   h. Discuss thread fit classifications
   i. Describe the common tapers used in the machine shop
   j. Discuss taper cutting and calculations for the lathe
   k. Use HSS cutting tools
   l. Use carbide cutting tools

COURSE OBJECTIVES: SCANS COMPETENCIES

The Secretary's Commission on Achieving Necessary Skills (SCANS), U.S. Department of Labor, has identified in its "AMERICA 2000 REPORT" that all students should develop a new set of competencies and foundation skills if they are to enjoy a productive, full and satisfying life. These are in addition to the Technical Workplace Competencies required by industry. SCANS is made up of five competencies and a three-part foundation of skills and personal qualities that are needed for solid job performance.

The following activities will be performed by each student for successful completion of this course:

I. COMPETENCIES

A. ***Resources:*** *Identifies, organizes, plans, and allocates resources*

1. follows a schedule to complete assigned tasks on time
2. follows a schedule to maximize laboratory resources
3. complete a stock request form for required material

B. ***Interpersonal:*** *Works with others*

1. complete assigned responsibilities within the shop floor serving as a member of the team
2. provide individual assistance/direction to peers as requested

C. ***Information:*** *Acquires and uses information*

1. read and interpret blueprints
2. organize and apply theories of machine tool operation
3. perform basic semi-precision and precision layout as necessary

D. ***Systems:*** *Understands complex inter-relationships*

1. demonstrate knowledge of the following systems:
   a. organization of personnel and facilities on the shop floor
   b. systematic approach to the metal removal process
   c. dimensioning and measurement systems
2. monitors and corrects performance during
   a. the machining process
   b. adjustments of individual laboratory work schedule
   c. constantly evaluating the quality of work to achieve acceptable standards

E. ***Technology:*** *Works with a variety of technologies*

1. chooses procedure, tools and equipment required to produce a part
2. applies appropriate procedures and uses appropriate tools and equipment to produce a machined part to acceptable standards

II. FOUNDATION SKILLS

A. ***Basic Skills:*** *Reads, writes, performs arithmetic and mathematical operations, listens and speaks.*

1. ***Reading:*** *Locates, understands, and interprets written information in prose and in documents such as manuals, graphs, and schedules*
   a. read/studies textbook
   b. studies student laboratory manual
   c. interprets blueprints and technical drawings
   d. follow a daily laboratory schedule to maintain appropriate time-line and product completion

2. ***Writing:*** *Communicates thoughts, ideas, information, and messages in writing; and creates documents such as letters, directions, manuals, reports, graphs, and flow charts*
   a. outline the steps necessary to produce a simple machine part
   b. maintain a lecture notebook
   c. submit written responses to chapter question assignments
   d. prepare job process for lathe and mill assignments

3. ***Arithmetic/Mathematics:*** *Perform basic computations and approaches practical problems by choosing appropriately from a variety of mathematical techniques*

a. determines optimum machining speeds, feeds, and depth of cut
b. interconverts fractions to decimal expressions
c. keeps a running computation of individual grade
d. calculate gage block buildup
e. calculate for turning tapers
f. calculate for indexing problems

4. ***Listening:*** *Receives, attends to, interprets, and responds to verbal messages and other cues*
   a. assimilate classroom instruction
   b. interpret and assimilate video instruction
   c. observe and assimilate laboratory demonstrations
   d. seek and receive individualized instruction in the laboratory
   e. practices active listening by affirming understanding of verbal instructions, asking questions for clarification and probing for specifics

5. ***Speaking:*** *Organizes ideas and communicates orally*
   a. participates in classroom discussions
   b. organize ideas and communicate specific questions to the instructor
   c. verbally affirms understanding of a concept, procedure, or required skill
   d. communicate with peers, instructors and supervisors to ensure the smooth and safe operation of the laboratory
   e. plan and deliver a 15-20 minute oral presentation on an assigned machine-related topic

B. ***Thinking Skills:*** *Thinks creatively, makes decisions, solves problems, visualizes, knows how to learn and reasons.*

1. ***Decision Making:*** *Specifies goals and constraints, generates alternatives, considers risks, and evaluates and chooses best alternative*
   a. decides upon a job process plan to produce a part to specifications, given constraints of available time, equipment and other resources
   b. prioritizes activities for effective use of time

2. ***Problem Solving:*** *Recognizes problems and devises and implements plan of action*
   a. makes daily accommodations to stay on schedule
   b. seeks additional instruction/clarification for assignment completion
   c. troubleshoots machining processes and equipment
   d. recognize problems in machining and selects appropriate corrective or preventive action

3. ***Seeing Things In the Mind's Eye:*** *Organizes, and processes symbols, pictures, graphs, objects, and other information*
   a. visualize objects in three dimensions from engineering drawings
   b. visualize process during instructor lecture
   c. visualize the relative motions between tool and workpiece to generate desired features in raw stock in order to plan machine setups and sequence of machining operations

4. ***Knowing How to Learn:*** *Use efficient learning techniques to acquire and apply new knowledge and skills*
   a. understand that practice will improve skill
   b. asks questions or seeks help when uncertain about new skills or knowledge
5. ***Reasoning:*** *Discovers a rule or principle underlying the relationship between two or more objects and applies it when solving a problem*
   a. applies knowledge of principles of machining to troubleshoot process problems
   b. applies knowledge of machining process to develop a logical, sequential process plan
   c. applies knowledge of workpiece machinability, cutter characteristics and machine tool characteristics to adjust speeds and feeds

C. ***Personal Qualities:*** *Displays responsibility, self-esteem, sociability, self-management, and integrity and honesty.*
1. ***Responsibility:*** *Exerts a high level of effort and perseveres towards goal attainment*
   a. displays promptness and preparation for the day's work
   b. plans work to use time efficiently
   c. accepts responsibility for mistakes, and takes corrective and preventive actions
   d. takes initiative when needed to gain resources or assistance to complete assignments
2. ***Self-Esteem:*** *Believes in own self-worth and maintains a positive view of self*
   a. takes pride in work through positive reinforcement
   b. sees self as a valued member of the group through continued contributions toward common goals
3. ***Sociability:*** *Demonstrates understanding, friendliness, adaptability, empathy, and politeness in group settings*
   a. assist classmates in improving technical skills
   b. share laboratory resources (machines, tools and instructor's individual attention)
4. ***Self-Management:*** *Assesses self accurately, sets personal goals, monitors progress, and exhibits self-control*
   a. perform in-process quality checks on machined parts
   b. maintain a record of academic achievement (individual grade book)
   c. accept responsibility for mistakes and infractions, and take steps to resolve or eliminate them
5. ***Integrity/Honesty:*** *Chooses ethical courses of action*
   a. accept the responsibility for own actions
   b. exhibit personal honesty at all times
   c. accept the challenge of doing your own work in the laboratory, during examination, and on outside assignments
   d. understand the consequences of unethical behaviors

Appropriate Reference Materials:

1. Machinery's Handbook, Industrial Press
2. Technology of Machine Tools, 4th Ed., McGraw Hill Publishers

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***M*achine Tool *A*dvanced *S*kills**
***T*echnology Program**

MAST

COURSE SYLLABUS

APPLICATION SOFTWARE

MAST PROGRAM
COURSE SYLLABUS
APPLICATION SOFTWARE

Lecture hours/week: 1 **Lab hours/week: 4** **Credit hours: 3**

COURSE DESCRIPTION:

This course covers introductory computer concepts combined with an emphasis on the more predominate computer software including, but not limited to DOS, word processing, electronic spreadsheets, and data bases thus providing non-majors with computer literacy and hands-on experience.

PREREQUISITES: **NONE**

REQUIRED COURSE MATERIALS:

Textbook: Microsoft Office Professional for Windows (Illustrated); by Halvorson, Swanson, Reding, Beskeen, and Johnson. Latest edition.

Lab Manual: **None**

Supplies/Quantity Required:

2 - High density disks (3 ½")
6 - Scantron test forms

METHODS OF INSTRUCTION:

Lecture: Didactic presentations will include lecture, video and demonstrations.

Laboratory: Laboratory will be a "hands-on" application of computer software.

Method of Evaluation: A student's grade will be based on multiple measures of performance. The assessment will measure development of independent critical thinking skills and will include evaluation of the student's ability to:

1. perform the computer skills as required to satisfactorily complete laboratory assignments
2. apply theory to laboratory assignments
3. satisfactorily perform on written, oral, and practical examinations
4. satisfactorily perform on outside assignments including writing assignments
5. contribute to class discussions
6. maintain attendance per current policy

LECTURE OUTLINE:

Lecture Topics	Text Reference Page	Contact Hrs.
DOS Commands		2
Review & Test - DOS Commands		1
Microsoft Windows 3.1		2
a. Getting started with Windows 3.1		
b. Creating and managing files		
Review & Test - Microsoft Windows 3.1		1
Microsoft Word 6.0		1
a. Getting started with Microsoft Word 6.0		
b. Creating and editing a document		
c. Formatting a document		
d. Arranging text and graphics		
Review & Test - Microsoft Word 6.0		1
Microsoft Excel 5.0		1
a. Getting started with Microsoft Excel 5.0		
b. Creating a worksheet		
c. Modifying a worksheet		
d. Working with charts		
e. Integrating Word and Excel		
Review & Test - Microsoft Excel 5.0		1
Microsoft Access 2.0		1
a. Getting started with Microsoft Access 2.0		
b. Creating a database		
c. Manipulating data		
d. Creating forms and reports		
Review & Test - Access 2.0 for Windows		1
	Total Lecture Hours	**12**

LAB OUTLINE:

Lab Topics	Contact Hrs.
Work with DOS Tutor (Sections 2, 4, 5, 6, and 7)	12
Microsoft Windows 3.1 (Units 1 and 2)	10
Microsoft Word 6.0 (Units 1, 2, 3, and 4)	10
Microsoft Excel 5.0 (Units 1, 2, 3, and 4)	8
Microsoft Access 2.0 (Units 1, 2, 3, and 4)	8
Total Lab Hours	**48**

COURSE OBJECTIVES: TECHNICAL COMPETENCIES

After the successful completion of this course the student will be able to:

A. USE COMPUTERS

1. Use Computer Operating Systems
   a. Use basic computer terminology appropriately and accurately
   b. Boot the computer and recognize the basic components of DOS
   c. Use DOS to perform file management
   d. Use DOS to perform directory management

e. Install software packages on a PC

2. Use Computer Inquiry Systems
   a. Log in to a multi-user system
   b. Access system for needed information
   c. Print reports as necessary
3. Use Various Computer Applications
   a. Load word processor, create, save, edit, and print a document
   b. Load spreadsheet, create, save, retrieve, erase, edit, and print a worksheet
   c. Load database programs, create, edit, delete, and print records in a database file

COURSE OBJECTIVES: SCANS COMPETENCIES

The Secretary's Commission on Achieving Necessary Skills (SCANS), U.S. Department of Labor, has identified in its "AMERICA 2000 REPORT" that all students should develop a new set of competencies and foundation skills if they are to enjoy a productive, full and satisfying life. These are in addition to the Technical Workplace Competencies required by industry. SCANS is made up of five competencies and a three-part foundation of skills and personal qualities that are needed for solid job performance.

The following activities will be performed by each student for successful completion of this course:

I. COMPETENCIES
   - *A. **Resources:** Identifies, organizes, plans, and allocates resources*
     1. follows a schedule to complete assigned tasks on time
   - *B. **Interpersonal:** Works with others*
     1. provide individual assistance/direction to peers as requested
     2. works well with all members of the class
   - *C. **Information:** Acquires and uses information*
     1. read and interpret textbooks
   - *D. **Systems:** Understands complex inter-relationships*
     1. demonstrate knowledge of the following systems:
        a. laboratory organization structure: physical and social
        b. systematic organization of training materials
     2. monitors and corrects performance during
        a. operation of computer hardware and software
        b. adjustments of individual laboratory work schedule
        c. constantly evaluating the quality of work to achieve acceptable standards
        d. maintains record of evaluations and sets individual goals
   - *E. **Technology:** Works with a variety of technologies*
     1. chooses procedure to successfully complete assignments

II. FOUNDATION SKILLS

A. ***Basic Skills:*** *Reads, writes, performs arithmetic and mathematical operations, listens and speaks.*

1. ***Reading:*** *Locates, understands, and interprets written information in prose and in documents such as manuals, graphs, and schedules*

a. studies student laboratory manual
b. read/studies textbook
c. follow a daily laboratory schedule to maintain appropriate time-line

2. ***Writing:*** *Communicates thoughts, ideas, information, and messages in writing; and creates documents such as letters, directions, manuals, reports, graphs, and flow charts*

a. maintain a lecture notebook
b. submit written responses to chapter question assignments
c. complete all written assignments

3. ***Listening:*** *Receives, attends to, interprets, and responds to verbal messages and other cues*

a. assimilate classroom instruction
b. interpret and assimilate video instruction
c. observe classroom demonstrations
d. seek and receive individualized instruction in the laboratory

4. ***Speaking:*** *Organizes ideas and communicates orally*

a. participates in classroom discussions
b. organize ideas and communicate specific questions to the instructor
c. verbally affirms understanding of a concept, procedure, or required skill

B. ***Thinking Skills***: Thinks creatively, makes decisions, solves problems, visualizes, knows how to learn and reasons.

1. ***Decision Making:*** *Specifies goals and constraints, generates alternatives, considers risks, and evaluates and chooses best alternative*

a. identifies personal goals
b. identifies actions required to accomplish personal goals

2. ***Problem Solving:*** *Recognizes problems and devises and implements plan of action*

a. makes daily accommodations to stay on schedule
b. seeks additional instruction/clarification for assignment completion
c. balances social and academic life/responsibilities
d. accepts responsibility

3. ***Seeing Things In the Mind's Eye:*** *Organizes, and processes symbols, pictures, graphs, objects, and other information*

a. interprets technical manuals
b. interprets technical illustrations and symbols
c. understands both written and verbal instructions
d. assimilates process during instructor demonstrations

4. ***Knowing How to Learn:*** *Use efficient learning techniques to acquire and apply new knowledge and skills*

a. demonstrate mastery of the basic skills and techniques
b. use these sequential skills to support mastery of new skills

c. understand the sequential nature of acquired skills and the subsequent knowledge application of new skills and techniques

5. ***Reasoning:*** *Discovers a rule or principle underlying the relationship between two or more objects and applies it when solving a problem*
   a. understands that practice may not make it perfect but it certainly will improve the skill of the operator

C. ***Personal Qualities:*** *Displays responsibility, self-esteem, sociability, self-management, and integrity and honesty.*

1. ***Responsibility:*** *Exerts a high level of effort and perseveres towards goal attainment*
   a. develops an understanding that in order to be successful you must be a "good" student
   b. develops an understanding that a "good" student is the one who is prompt to every class and has prepared for the day's work
   c. develops an understanding good students know what they are going to do in class and does not waste time
   d. develops a fine work-ethic

2. ***Self-Esteem:*** *Believes in own self-worth and maintains a positive view of self*
   a. learns to take pride in his or her work through positive reinforcement
   b. sees himself or herself as an asset to the class through continued contributions to the group and a shared common goal
   c. understands that an individual with a positive attitude and the belief in their own abilities will systematically seek solutions and be a valuable employee

3. ***Sociability:*** *Demonstrates understanding, friendliness, adaptability, empathy, and politeness in group settings*
   a. assist classmates in improving computer skills
   b. assist students with special needs as a peer mentor

4. ***Self-Management:*** *Assesses self accurately, sets personal goals, monitors progress, and exhibits self-control*
   a. perform in-process checks of work
   b. maintain a record of academic achievement (individual gradebook)
   c. accept the responsibility for self-management

5. ***Integrity/Honesty:*** *Chooses ethical courses of action*
   a. accept the responsibility for own actions
   b. exhibit personal honesty at all times
   c. accept the challenge of doing your own work in the laboratory, during examination, and on outside assignments
   d. understand the consequences of unethical behaviors

***M*achine Tool *A*dvanced *S*kills**
***T*echnology Program**

MAST

COURSE SYLLABUS

ENGINEERING MATERIALS

Prerequisite: MACHINE TOOL PRACTICES II

MAST PROGRAM
COURSE SYLLABUS
ENGINEERING MATERIALS

Lecture hours/week: 2 **Lab hours/week: 3** **Credit hours: 3**

COURSE DESCRIPTION:

Engineering Materials is the study of materials used in the manufacture of products produced by a variety of manufacturing processes. Topics will include the characteristics and properties of both metallic and nonmetallic materials used in the design of products. Students will conduct tests on materials, collect data and interpreting that data.

PREREQUISITES: **Machine Tool Practices I**
Machine Tool Practices II
College Algebra

REQUIRED COURSE MATERIALS:

Textbook: Practical Metallurgy and Materials of Industry, John Neely, Wiley Pub., 3rd Ed.
Lab Manual: NONE

Tools and Equipment/Quantity Required:

Safety Glasses	1
Scientific Calculator	1

METHODS OF INSTRUCTION:

Lecture: Didactic presentations will include lecture, video and demonstrations.

Laboratory: Laboratory will be "hands-on" activities.

Method of Evaluation: A student's grade will be based on multiple measures of performance. The assessment will measure development of independent critical thinking skills and will include evaluation of the student's ability to:

1. perform the manipulative skills of the craft as required to satisfactorily complete laboratory assignments
2. apply theory to laboratory assignments
3. satisfactorily perform on written, oral, and practical examinations
4. satisfactorily perform on outside assignments including writing assignments
5. contribute to class discussions
6. maintain attendance per current policy
7. follow all shop rules and safety regulations as stated in the laboratory manual

LECTURE OUTLINE:

Lecture Topic	Text Reference Page	Contact Hrs.
Extracting Metals from Ores	12-28	
The Manufacture of Steel Products	32-41	
Identification and Selection of Iron & Steels	44-50	
Identification on Nonferrous Metals	52-64	
Identification and Selection of Nonmetallic Materials		
The Mechanical and Physical Properties of Materials	70-86	
Rockwell and Brinell Hardness Testers	92-98	
The Crystalline Structure of Materials	102-123	
Phase Diagrams and the Iron-Carbon Diagram	127-142	
Hardening and Tempering of Carbon Steels	145-151	
Annealing, Normalizing and Stress Relieving	155-163	
I-T Diagrams and Cooling Curves	165-173	
Harden ability of Steels and Tempered Martensite	175-183	
Heat-Treatment Equipment and Procedures	185-206	
Heat Treatment of Nonferrous Metals	207-207	
	Total Lecture Hours	**24**

LAB OUTLINE:

Lab Topics	Contact Hrs.
Using Hardness Testers	6
a) Standard Rockwell Hardness Tester	
b) Superficial Rockwell Tester	
c) Automatic Rockwell Hardness Tester	
d) Shores Tester	
e) Brinell Tester	
f) Vickers Tester	
Microscopic Examination of Specimens	12
Determination of Critical Temperature of Steels	6
Tempering of Hardened Materials	4
Impact Testing	4
Determining the Harden ability of Steels	4
Total Lab Hours	**36**

COURSE OBJECTIVES: TECHNICAL COMPETENCIES

After the successful completion of this course the student will be able to:

A. PRACTICE SAFETY

1. Follow Safety Manuals and All Safety Regulations/Requirements
   a. Assume responsibility for the personal safety of oneself and others

b. Develop a personal attitude towards safety
c. Interpret safety manual directives
d. Comply with established company safety practices

2. Use Protective Equipment
   a. Wear protective safety clothing as required
   b. Maintain and use protective guards and equipment on machinery
   c. Locate and properly use protective equipment
   d. Use lifting aids when necessary
   e. Know the location(s) and type of fire extinguishers
   f. Review procedures for using emergency eye-wash station
3. Follow Safe Operating Procedures for Hand and Machine Tools
   a. Identify and understand safe machine operating procedures
   b. Demonstrate safe machine operation
4. Maintain a Clean and Safe Work Environment
   a. Keep work areas clean
   b. Clean machine/hand tools when work is completed
   c. Put tools away when work is finished
   d. Keep aisles clear of equipment and materials

B. APPLY MATHEMATICAL CONCEPTS

1. Perform Basic Arithmetic Functions
   a. Add, subtract, multiply and divide whole numbers
   b. Add, subtract, multiply, and divide fractions
   c. Add, subtract, multiply, and divide decimals
2. Interconvert Fractions/Decimals
   a. Convert fractions to decimal equivalents
   b. Convert decimal values to nearest fractional equivalent
   c. Use Decimal Equivalent Chart for conversions
3. Interconvert Metric/English Measurements
   a. Convert English dimensions to Metric
   b. Convert Metric dimensions to English
   c. Use Metric/English conversion chart
4. Perform Basic Trigonometric Functions
   a. Solve for unknown angles
   b. Solve for unknown sides
5. Calculate Speeds and Feeds for Machining
   a. Calculate RPM for various metals and various tools
   b. Calculate feed for various metals, tools, and depths of cut

C. INTERPRET ENGINEERING DRAWINGS AND CONTROL DOCUMENTS

1. Review Blueprint Notes and Dimensions
   a. Explain basic blueprint terminology
   b. Identify the types of dimensions
   c. Identify general note symbols
   d. Locate notes on a print
   e. Interpret commonly used abbreviations and terminology
   f. Determine tolerances associated with dimensions on a drawing
   g. Determine the tolerance for a reference dimension
   h. Determine the surface finish for a given part
   i. List the essential components found in the general drawing notes

D. RECOGNIZE DIFFERENT MANUFACTURING MATERIALS AND PROCESSES

1. Identify Materials With Desired Properties
   a. Discuss classification system for metals
   b. Discuss general characteristics for carbon steels, stainless steels, structural steels, cast irons, aluminum, and other commonly used metals
   c. List advantages for considering plastic as a viable materials choice
   d. List the advantages and disadvantages for each of the following plastic molding processes: blow, injection, vacuum, and extrusion
   e. Discuss the advantages for using composites in various manufacturing applications
2. Describe Heat Treating Processes
   a. Discuss the reasons for heat treating
   b. Discuss the time/temperature chart
   c. List the different quenching mediums
   d. Estimate metal temperature by color
   e. List reasons for stress relieving work piece
   f. Discuss surface hardening processes
3. Perform Heat Treating Operations
   a. Harden plain carbon steel work pieces
   b. Temper plain carbon steel work pieces
   c. Anneal plain carbon steel work pieces
   d. Case harden mild steel work pieces
4. Test Metal Samples for Hardness
   a. Perform spark test on carbon steels
   b. Perform Rockwell hardness tests
   c. Perform Brinell hardness tests

COURSE OBJECTIVES: SCANS COMPETENCIES

The Secretary's Commission on Achieving Necessary Skills (SCANS), U.S. Department of Labor, has identified in its "AMERICA 2000 REPORT" that all students should develop a new set of competencies and foundation skills if they are to enjoy a productive, full and satisfying life. These are in addition to the Technical Workplace Competencies required by industry. SCANS is made up of five competencies and a three-part foundation of skills and personal qualities that are needed for solid job performance.

The following activities will be performed by each student for successful completion of this course:

I. COMPETENCIES

A. ***Resources:*** *Identifies, organizes, plans, and allocates resources*
   1. follows a schedule to complete assigned tasks on time
   2. determine the initial cost of materials and "value added" as result of machining
   3. complete a stock request form for required material

4. provide a self-evaluation of performance based on the time and quality of work

B. ***Interpersonal:*** *Works with others*

1. complete assigned responsibilities within the shop floor serving as a member of the team
2. provide individual assistance/direction to peers as requested
3. produce machine parts to acceptable levels of quality as required
4. works well with all members of the class

C. ***Information:*** *Acquires and uses information*

1. read and interpret blueprints
2. organize and apply theories of machine tool operation
3. perform basic semi-precision and precision layout as necessary

D. ***Systems:*** *Understands complex inter-relationships*

1. demonstrate knowledge of the following systems:
   a. laboratory organization structure: physical and social
   b. organization of personnel and facilities on the shop floor
   c. systematic approach to the metal removal process
   d. dimensioning and measurement systems
   e. systematic organization of training materials
2. monitors and corrects performance during
   a. the machining process
   b. adjustments of individual laboratory work schedule
   c. constantly evaluating the quality of work to achieve acceptable standards
   d. maintains record of evaluations and sets individual goals

E. ***Technology:*** *Works with a variety of technologies*

1. chooses procedure, tools and equipment required to produce a part
2. applies appropriate procedures and uses appropriate tools and equipment to produce a machined part to acceptable standards
3. maintains and troubleshoots equipment
   a. applies appropriate preventative maintenance
   b. when operating machines
   c. reports all malfunctions of equipment to supervisor/instructor
   d. perform clean-up assignments of machine and shop floor at the end of the laboratory

II. FOUNDATION SKILLS

A. ***Basic Skills:*** *Reads, writes, performs arithmetic and mathematical operations, listens and speaks.*

1. ***Reading:*** *Locates, understands, and interprets written information in prose and in documents such as manuals, graphs, and schedules*

   a. studies student laboratory manual
   b. interprets blueprints and technical drawings
   c. read/studies textbook
   d. follow a daily laboratory schedule to maintain appropriate time-line and product completion

2. ***Writing:*** *Communicates thoughts, ideas, information, and messages in writing; and creates documents such as letters, directions, manuals, reports, graphs, and flow charts*
   a. outline the steps necessary to produce a simple machine part
   b. maintain a lecture notebook
   c. submit written responses to chapter question assignments
   d. complete all written assignments
3. ***Arithmetic/Mathematics:*** *Perform basic computations and approaches practical problems by choosing appropriately from a variety of mathematical techniques*
   a. determines optimum machining speeds, feeds, and depth of cut
   b. calculates "value added to the part"
   c. aligns machine and/or work holding device
   d. taps and threads
   e. keeps a running computation of individual grade
   f. interconverts fractions to decimal expressions
   g. use protractors to lay-out angle machining
   h. use trigonometry to solve angle and taper calculations
4. ***Listening:*** *Receives, attends to, interprets, and responds to verbal messages and other cues*
   a. assimilate classroom instruction
   b. interpret and assimilate video instruction
   c. observe laboratory demonstrations
   d. seek and receive individualized instruction in the laboratory
5. ***Speaking:*** *Organizes ideas and communicates orally*
   a. participates in classroom discussions
   b. organize ideas and communicate specific questions to the instructor
   c. verbally affirms understanding of a concept, procedure, or required skill
   d. communicates with peers to ensure the smooth and safe operation of the laboratory

B. ***Thinking Skills:*** *Thinks creatively, makes decisions, solves problems, visualizes, knows how to learn and reasons.*
1. ***Decision Making:*** *Specifies goals and constraints, generates alternatives, considers risks, and evaluates and chooses best alternative*
   a. identifies personal goals
   b. identifies actions required to accomplish personal goals
2. ***Problem Solving:*** *Recognizes problems and devises and implements plan of action*
   a. makes daily accommodations to stay on schedule
   b. seeks additional instruction/clarification for assignment completion
   c. balances social and academic life/responsibilities
   d. accepts responsibility
3. ***Seeing Things In the Mind's Eye:*** *Organizes, and processes symbols, pictures, graphs, objects, and other information*
   a. interprets technical drawings
   b. interprets technical illustrations and symbols
   c. understands both written and verbal instructions

d. assimilates process during instructor demonstrations

4. ***Knowing How to Learn:*** *Use efficient learning techniques to acquire and apply new knowledge and skills*
   a. demonstrate mastery of the basic skills and techniques
   b. use these sequential skills to support mastery of new skills
   c. understand the sequential nature of acquired skills and the subsequent knowledge application of new skills and techniques

5. ***Reasoning:*** *Discovers a rule or principle underlying the relationship between two or more objects and applies it when solving a problem*
   a. understands that practice may not make it perfect but it certainly will improve the skill of the operator
   b. understands that the quality of the product is a function of the time of the operation and the attitude and skill of the machinist
   c. understands the relationship between different metals and the tool applied to the metal surface and adjusts machining parameters accordingly

C. ***Personal Qualities:*** *Displays responsibility, self-esteem, sociability, self-management, and integrity and honesty.*

1. ***Responsibility:*** *Exerts a high level of effort and perseveres towards goal attainment*
   a. develops an understanding that in order to be successful you must be a "good" student
   b. develops an understanding that a "good" student is the one who is prompt to every class and has prepared for the day's work
   c. develops an understanding good students know what they are going to do in class and does not waste time
   d. develops a fine work-ethic

2. ***Self-Esteem:*** *Believes in own self-worth and maintains a positive view of self*
   a. learns to take pride in his or her work through positive reinforcement
   b. sees himself or herself as an asset to the class through continued contributions to the group and a shared common goal
   c. understands that an individual with a positive attitude and the belief in their own abilities will systematically seek solutions and be a valuable employee

3. ***Sociability:*** *Demonstrates understanding, friendliness, adaptability, empathy, and politeness in group settings*
   a. assist classmates in improving technical skills
   b. assist students with special needs as a peer mentor
   c. share laboratory resources (machines, tools and instructor's individual attention)

4. ***Self-Management:*** *Assesses self accurately, sets personal goals, monitors progress, and exhibits self-control*
   a. perform in-process quality checks on machined parts
   b. maintain a record of academic achievement (individual grade book)
   c. make accommodations to laboratory schedules due to broken machines/tools

d. accept the responsibility for self-management

5. ***Integrity/Honesty:*** *Chooses ethical courses of action*
   a. accept the responsibility for own actions
   b. exhibit personal honesty at all times
   c. accept the challenge of doing your own work in the laboratory, during examination, and on outside assignments
   d. understand the consequences of unethical behaviors

Appropriate Reference Materials:

1. Machinery's Handbook, Industrial Press
2. Technology of Machine Tools, 4th Ed., McGraw Hill Publishers

MET112
01/072396

*M*achine Tool *A*dvanced *S*kills
*T*echnology Program

MAST

COURSE SYLLABUS

SAFETY AND ACCIDENT PREVENTION

MAST PROGRAM
COURSE SYLLABUS
SAFETY AND ACCIDENT PREVENTION

Lecture hours/week: 2 **Lab hours/week: 3** **Credit hours: 3**

COURSE DESCRIPTION:

A course designed to enable the student to recognize hazards and potential hazards which may occur in the workplace and to take corrective action. The course may be directed toward a specific technology as required. Federal safety requirements under the OSHA law will be emphasized. General supervisor safety training course for all technologies.

PREREQUISITES: **NONE**

REQUIRED COURSE MATERIALS:

Textbook: Supervisor's Safety Manual, National Safety Council, 8th Edition
Lab Manual: **NONE**

Hand Tools/Quantity Required:
Notebook paper
Notebook
Pencils or pens

METHODS OF INSTRUCTION:

Lecture: Didactic presentations will include lecture, demonstrations, and the following training materials and visual aids (OSH Film Library):
"The Convincer" - 45 min. color slide
"Safety and the Supervisor - 16 mm - color film
"All About OSHA" - 16 mm - color film
"Search for Safety" - 16 mm - color film
"In Search of the Facts" - 16 mm - color film
"Color of Danger" - 16 mm - color film
"Six Ways to Lift" - 16 mm - color film
"MGM Grand Hotel Fire" - 16 mm - color film

Laboratory: Laboratory assignments will require students to recognize hazards and potential hazards which may occur in the workplace and to take corrective action.

Method of Evaluation: A student's grade will be based on multiple measures of performance. The assessment will measure development of independent critical thinking skills and will include evaluation of the student's ability to:

1. perform the manipulative skills of the craft as required to satisfactorily complete laboratory assignments
2. satisfactorily perform on written, oral, and practical examinations
3. explain all the elements of good communication as it relates to safety
4. apply several human relations concepts as a supervisor to ensure safety in the work place
5. discuss the importance of industrial hygiene and noise control
6. correctly fill out an accident investigation report and a safety inspection form
7. discuss and/or demonstrate the use of personal protective equipment
8. apply the principles of and discuss the benefits of machine safeguarding
9. explain and/or demonstrate the use and safe handling of hand and portable power tools
10. discuss safe electrical procedures
11. discuss the basic principles and causes of fire
12. explain the need for safety training of workers
13. satisfactorily perform on outside assignments including writing assignments
14. contribute to class discussions
15. maintain attendance per current policy
16. follow all shop rules and safety regulations as stated in the laboratory manual

LECTURE OUTLINE:

Lecture Topics	Text Reference Page	Contact Hrs.
Introduction		1
Course content and text		
Attendance and grading		
Testing procedures		
The origin of the safety movement		
The Williams-Steiger Act		
OSHAct applied to technology		
Safety Management		1
Definition of terms		
Areas of responsibility		
The "old" approach to safety performance		
A better approach to safety performance		
Summary of Key Points		
Communications		1
Elements of communication		
Methods of communication		
Effective listening		
Summary of key points		
Human Relations		1
Human relations concepts		
Leadership		
Coping with difficult problems		
Shift work and shift changes		
Stress management		
Alcohol and drug problems		
Employee assistance programs		
Summary of key points		
Employee Safety Training		1

Orientation training	
Job instruction training	
Other methods of instruction	
Job safety analysis	
Summary of key points	
Employee Improvement	1
Promoting safety among workers	
Off-the-job accident problems	
Summary of key points	
EXAM #1	1
Safety Inspections	1
Formal inspections	
Inspection planning and procedures	
Inspecting work practices	
Inspection reports	
Summary of key points	
Accident Investigation	1
Accident reporting	
Finding causes	
Emergency procedures	
Effective use of witnesses	
Accident investigation reports	
Summary of key points	
EXAM #2	1
Industrial Hygiene	1
Chemical stresses	
Physical stresses	
Ergonomic stresses	
Biological stresses	
Threshold limit values	
Standard Operating Procedures (SOP)	
Summary of key points	
EXAM #3	1
Personal Protective Equipment	1
Controlling hazards	
Head protection	
Face protection	
Eye protection	
Ear protection	
Respiratory protection	
Body protection	
Protecting extremities	
Summary of key points	
EXAM #4	1
Ergonomics	1
What are ergonomic problems?	
Understanding ergonomics	
Materials movement	

Work space and body characteristics
Hand work and use of tools
Whole-body vibration
Video display terminals
Lighting, noise, and heat
Summary of key points
EXAM #5 1
Machine Safeguarding 1
Principles of guarding
Safeguard design
Safeguarding mechanisms
Automation
Maintenance of safeguards
Summary of key points
Hand Tools and Portable Power Tools 1
Safe work practices
Use of hand tools
Portable power tools
Supervisory considerations
Maintenance and repair
Summary of key points
Materials Handling and Storage 1
Materials handling problems
Manual handling methods
Materials handling equipment
Ropes, chains, and slings
Materials storage
Summary of key points
EXAM #6 1
Electrical Safety 1
Myths and misconception about electricity
Electrical fundamentals review
Branch circuits and grounding concepts
Plug and cord connected equipment and extension cords
Branch circuit and equipment testing methods
Ground-fault circuit interrupters
Hazardous locations
Electrical standards most often violated
Inspection guidelines and checklist
Safeguards for portable home electrical appliances
Safety program policy and procedures
Electrical distribution system review
Summary of key points
Fire Safety 1
Basic principles
Causes of fire

Other hazardous materials	
Effective housekeeping for fire safety	
Fire prevention inspections	
Alarms, equipment, and evacuation	
Fire protection education	
Protective insurance requirements	
Summary of key points	
EXAM #7	1
Total Lecture Hours	**24**

LAB OUTLINE:

Lab Topics	Contact Hrs.
Students will research each chapter of the Supervisor's Safety Manual and answer questions which cover the main points of the chapter	16
Students will demonstrate the six steps in proper lifting	4
Students will demonstrate the proper use of powered hand tools	6
Students will demonstrate the use of different types of fire extinguishers	6
Students will explain the importance of inspecting electrical extension cords, plugs and cord-connected equipment	4
Total Lab Hours	**36**

COURSE OBJECTIVES: TECHNICAL COMPETENCIES

After the successful completion of this course the student will be able to:

A. PRACTICE SAFETY

1. Follow Safety Manuals and All Safety Regulations/Requirements
   a. Assume responsibility for the personal safety of oneself and others
   b. Develop a personal attitude towards safety
   c. Interpret safety manual directives
   d. Comply with established company safety practices
   e. Complete forms/paperwork as required
2. Use Protective Equipment
   a. Wear protective safety clothing as required
   b. Maintain and use protective guards and equipment on machinery
   c. Locate and properly use protective equipment
   d. Use lifting aids when necessary
3. Follow Safe Operating Procedures for Hand and Machine Tools
   a. Identify and understand safe machine operating procedures
   b. Demonstrate safe machine operation
4. Maintain a Clean and Safe Work Environment
   a. Keep work areas clean
   b. Clean machine/hand tools when work is completed
   c. Put tools away when work is finished
   d. Keep aisles clear of equipment and materials

e. Perform preventative maintenance as required

5. Control Fire Hazards
   a. Handle/store flammable materials appropriately
   b. Use electricity correctly (e.g., defective outlets, frayed cords, "burning" odor)
   c. Prevent spontaneous ignition by practicing proper waste disposal habits
   d. Keep marked aisles clear of equipment and materials
   e. Interpret/display MSDS sheets as required
   f. Identify fire exits and fire-fighting equipment
6. Apply American Red Cross First Aid and CPR Procedures
   a. Notify appropriate personnel of injury
   b. Check and evaluate life-endangering conditions
   c. Determine need for CPR
   d. Apply appropriate first aid techniques
   e. Complete accident report as needed
7. Recommend Hazardous Waste Management Techniques
   a. Define the types of hazards (e.g., chemical, biological, and physical)
   b. Evaluate and determine hazards
   c. Interpret MSDS sheets
   d. Describe the proper collection for a variety of hazardous wastes
   e. Respond to emergencies in the appropriate manner
8. Apply Ergonomic Principles to the Workplace
   a. Define ergonomics
   b. Explain the characteristics and potential impact of ergonomics on design, productivity, and safety
9. Demonstrate Knowledge of State and Federal EPA Regulations
   a. Meet health, safety, and legal requirements with regard to process, product and people

COURSE OBJECTIVES: SCANS COMPETENCIES

The Secretary's Commission on Achieving Necessary Skills (SCANS), U.S. Department of Labor, has identified in its "AMERICA 2000 REPORT" that all students should develop a new set of competencies and foundation skills if they are to enjoy a productive, full and satisfying life. These are in addition to the Technical Workplace Competencies required by industry. SCANS is made up of five competencies and a three-part foundation of skills and personal qualities that are needed for solid job performance.

The following activities will be performed by each student for successful completion of this course:

I. COMPETENCIES

A. Resources: Identifies, organizes, plans, and allocates resources

1. follows a schedule to complete assigned tasks on time
2. provide a self-evaluation of performance based on the time and quality of work

B. *Interpersonal: Works with others*
   1. provide individual assistance/direction to peers as requested
   2. works well with all members of the class

C. *Information: Acquires and uses information*
   1. studies safety materials and completes assignments
   2. makes safety recommendations based on classroom instruction

D. *Systems: Understands complex inter-relationships*
   1. demonstrate knowledge of the following systems
      a. laboratory organization structure: physical and social
      b. organization of personnel and facilities in the lab
      c. systematic organization of training materials
   2. monitors and corrects performance during
      a. adjustments of individual laboratory work schedule
      b. maintains record of evaluations and sets individual goals

E. *Technology: Works with a variety of technologies*
   1. apply fire safety principles
   2. apply hazardous material handling principles
   3. apply ergonomic principles to the workplace

II. **FOUNDATION SKILLS**

A. ***Basic Skills:*** *Reads, writes, performs arithmetic and mathematical operations, listens and speaks.*
   1. ***Reading:*** *Locates, understands, and interprets written information in prose and in documents such as manuals, graphs, and schedules*
      a. studies student laboratory manual
      b. read/studies textbook
      c. follow a daily laboratory schedule to maintain appropriate time-line and product completion
   2. ***Writing:*** *Communicates thoughts, ideas, information, and messages in writing; and creates documents such as letters, directions, manuals, reports, graphs, and flow charts*
      a. maintain a lecture notebook
      b. submit written responses to chapter question assignments
      c. complete all written assignments
   3. ***Listening:*** *Receives, attends to, interprets, and responds to verbal messages and other cues*
      a. assimilate classroom instruction
      b. interpret and assimilate video instruction
      c. observe laboratory demonstrations
      d. seek and receive individualized instruction in the laboratory
   4. ***Speaking:*** *Organizes ideas and communicates orally*
      a. participates in classroom discussions
      b. organize ideas and communicate specific questions to the instructor
      c. verbally affirms understanding of a concept, procedure, or required skill
      d. communicates with peers to ensure the smooth and safe operation of the laboratory

B. ***Thinking Skills:*** *Thinks creatively, makes decisions, solves problems, visualizes, knows how to learn and reasons.*

1. ***Decision Making:*** *Specifies goals and constraints, generates alternatives, considers risks, and evaluates and chooses best alternative*
   a. identifies personal goals
   b. identifies actions required to accomplish personal goals
2. ***Problem Solving:*** *Recognizes problems and devises and implements plan of action*
   a. makes daily accommodations to stay on schedule
   b. seeks additional instruction/clarification for assignment completion
   c. balances social and academic life/responsibilities
   d. accepts responsibility
3. ***Seeing Things In the Mind's Eye:*** *Organizes, and processes symbols, pictures, graphs, objects, and other information*
   a. understands both written and verbal instructions
   b. assimilates process during instructor demonstrations
4. ***Knowing How to Learn:*** *Use efficient learning techniques to acquire and apply new knowledge and skills*
   a. demonstrate mastery of the basic skills and techniques
   b. use these sequential skills to support mastery of new skills
   c. understand the sequential nature of acquired skills and the subsequent knowledge application of new skills and techniques
5. ***Reasoning:*** *Discovers a rule or principle underlying the relationship between two or more objects and applies it when solving a problem*
   a. understands that practice may not make it perfect but it certainly will improve the skill of the student

C. ***Personal Qualities:*** *Displays responsibility, self-esteem, sociability, self-management, and integrity and honesty.*

1. ***Responsibility:*** *Exerts a high level of effort and perseveres towards goal attainment*
   a. develops an understanding that in order to be successful you must be a "good" student
   b. develops an understanding that a "good" student is the one who is prompt to every class and has prepared for the day's work
   c. develops an understanding good students know what they are going to do in class and does not waste time
   d. develops a fine work-ethic
2. ***Self-Esteem:*** *Believes in own self-worth and maintains a positive view of self*
   a. learns to take pride in his or her work through positive reinforcement
   b. sees himself or herself as an asset to the class through continued contributions to the group and a shared common goal
   c. understands that an individual with a positive attitude and the belief in their own abilities will systematically seek solutions and be a valuable employee
3. ***Sociability:*** *Demonstrates understanding, friendliness, adaptability, empathy, and politeness in group settings*

a. assist classmates in improving technical skills
b. assist students with special needs as a peer mentor
c. share laboratory resources (machines, tools and instructor's individual attention)

4. ***Self-Management:*** *Assesses self accurately, sets personal goals, monitors progress, and exhibits self-control*
   a. maintain a record of academic achievement (individual grade book)
   b. make accommodations to laboratory schedules due to broken machines/tools
   c. accept the responsibility for self-management

5. ***Integrity/Honesty:*** *Chooses ethical courses of action*
   a. accept the responsibility for own actions
   b. exhibit personal honesty at all times
   c. accept the challenge of doing your own work in the laboratory, during examination, and on outside assignments
   d. understand the consequences of unethical behaviors

Appropriate Reference Materials:

OSH216
01/072396

*M*achine Tool *A*dvanced *S*kills
*T*echnology Program

MAST

COURSE SYLLABUS

BASIC FLUID POWER

Prerequisites: MATHEMATICS FOR INDUSTRIAL TECHNICIANS, BASIC ALGEBRAIC CONCEPTS, OR EQUIVALENT

MAST PROGRAM
COURSE SYLLABUS
BASIC FLUID POWER

Lecture hours/week: 3 **Lab hours/week: 3** **Credit hours: 4**

COURSE DESCRIPTION:

A basic study of hydraulic system components, fluid power theory, problem solving and troubleshooting techniques.

PREREQUISITES: **Mathematics for Industrial Technicians, Basic Algebraic Concepts, or equivalent**

REQUIRED COURSE MATERIALS:

Textbook: Industrial Hydraulic Technology, Parker Hannifin Corp.
Lab Manual: **NONE**

Supplies Required:

Electronic Pocket Calculator (Texas Instruments Model No. TI-35 or equivalent
Ruler-plastic, 12-inch, graduated in inches and centimeters
Notebook
Ballpoint pen
#2 Pencil (6)

METHODS OF INSTRUCTION:

Lecture: Didactic presentations will include lecture, video and demonstrations.

Laboratory: Laboratory will be "hands-on" activities.

Method of Evaluation: A student's grade will be based on multiple measures of performance. The assessment will measure development of independent critical thinking skills and will include evaluation of the student's ability to:

1. perform the manipulative skills of the craft as required to satisfactorily complete laboratory assignments
2. apply theory to laboratory assignments
3. satisfactorily perform on written, oral, and practical examinations
4. satisfactorily perform on outside assignments including writing assignments
5. contribute to class discussions
6. maintain attendance per current policy
7. follow all shop rules and safety regulations as stated in the laboratory manual

LECTURE OUTLINE:

Lecture Topics	Text Reference Page	Contact Hrs.
Introduction		1
A. Historical background		
B. Advantages and application of hydraulic power		
1) List five advantages of hydraulic power		
2) List five examples of the application of hydraulic power		
C. Overview of a typical hydraulic system		
1) Identify by name and describe the function of the major components of a basic hydraulic system		
2) Sketch or identify the ANSI standard symbol for each major component		
Basic Principles of Hydraulics		8
A. Pressure and force relationships		
1) State or describe the consequences of Pascal's law		
2) Knowing the basic mathematical relationship of pressure, force, and area, solve for any <u>one</u> given the other <u>two</u>		
B. Principles and Concepts of Fluid Pressure and Flow		
1) Given the density or specific gravity of a fluid, calculate the pressure head for a given fluid height		
2) State Bernoulli's Theory in terms of velocity and pressure		
3) Using the Continuity Equation, solve for hydraulic line size given the flow rate and velocity parameters; determine cylinder extension speed (or time) given flow rate and cylinder size; determine flow		

velocity in various sized lines given flow rate

4) State the results of Torricelli's Theories in terms of pressure head and velocity

5) Use the Reynolds Number to determine laminar or turbulent flow

6) Given the movement of a load in a given time interval, calculate work, power, and horsepower

7) Analyze a hydraulic system to determine its performance given the specifications of the pump and various actuators (cylinders, hydraulic motors, rotary actuators)

Hydraulic Fluids 3

A. Types, properties, and safety

1) Name three types of hydraulic fluid

2) List two methods of measuring fluid viscosity

3) List four desirable characteristics of a hydraulic fluid

4) Given a hypothetical hydraulic system configuration, identify the safety hazards and means of correction

B. Fluid storage and conditioning

1) List five features of a well-designed hydraulic reservoir

2) Name two types of heat exchangers

3) Name two basic types of filter elements

4) Explain what is meant by the micron rating of filters

5) List three benefits derived from proper conditioning of hydraulic fluid

Power, Distribution and Sealing Devices 2

A. Lines, hoses and fittings

1) Given the pressures and flow rates of a system, select the correct tubing size for a

properly designed hydraulic system

2) Show actual or illustrated hose installations, identify improper installation and recommend an acceptable configuration

3) Show actual or illustrated tubing connectors, properly identify them within the two main classifications

B. Pressure, velocity, and safety factors

1) Using Barlow's Formula, or a proper reference chart, determine the allowable maximum pressure of a given conductor

2) Determine working pressure of a system given the safety factor

3) Using Darcy's Formula, calculate the pressure drop of a given length of conductor

4) Given the Reynold's Number, determine whether the flow is laminar or turbulent

5) Using a nomograph, determine the flow rate, conductor size, or flow velocity given any two parameters

6) Determine hydraulic pump inlet and discharge line size given the flow rate, using the Continuity Equation and accepted industrial velocity parameters

C. Sealing devices

1) List three conditions affecting the selection of sealing devices

2) Name the three general categories of sealing materials

Pumps 3

A. Types and operation

1) Name the two general classifications of pumps

2) List the design features, main uses, and describe the operation of each of the two

types of pumps

3) Know why positive displacement pumps are preferred for fluid power systems

B. Theory and calculations

1) Calculate the theoretical output flow and input torque of a positive displacement pump
2) Determine overall pump efficiency
3) Determine the volumetric efficiency of a pump
4) Determine the mechanical efficiency of a pump
5) Calculate the hydraulic horsepower output of a pump

C. Design and selection factors

1) Name three types of positive displacement pumps; list the advantages /disadvantages of each
2) Name two types of variable delivery pumps and describe their operation
3) Using catalog or advertising data, evaluate various pumps for use in specific applications

Hydraulic Actuators 2

A. Linear actuators (cylinders)

1) Name two of the most common types of cylinders
2) Describe how cylinders are rated and sized
3) Using an illustration or actual cylinder, name and identify the parts
4) Given the size of a cylinder and the system flow rate, calculate the cylinder extension speed or extension time
5) Given system flow and pressure, or load, stroke, and extension time, calculate the power output of a cylinder

B. Rotary actuators and motors
   1) Name the two general types of hydraulic motors
   2) Name the three principle elements of motor ratings
   3) Given displacement and flow rate, calculate motor speed (rpm)
   4) Given the torque and rpm of a motor, calculate the hydraulic horsepower

Hydraulic Controls 8

A. Control of hydraulic power
   1) Name the three primary ways of controlling pressurized hydraulic fluid
   2) Name five types of pressure control valves and describe their use and operation
   3) Name at least four types or designs of directional control valves and describe their use
   4) Describe the function of flow control valves and name three types or designs

B. Hydraulic circuits
   1) Describe the function of pressure controls for sequencing actuators, counterbalances or braking applications, safety or relief operations, pressure reducing and unloading functions
   2) Explain the function and proper application of meter-in, meter-out, and bleed-off circuits
   3) Explain the function of a three-position directional control valve and name four common center designs
   4) Describe the use and limitations of a regenerative circuit
   5) Describe the difference

between a hydrostatic transmission and a hydrostatic drive and give three applications

Hydraulic System Troubleshooting 2

A. Define component relationships
   1) Given a real or hypothetical hydraulic system, trace the flow through the entire system, state the purpose of each component, and describe the action or operation of each component at each control setting

B. Analyze pressure and flow
   1) Name the three common terms used when referring to pressure within a hydraulic system
   2) Describe the causes of each of the three kinds of system pressure
   3) Describe the effect of increased or decreased flow on actuator operation
   4) Describe the effect of increased or decreased pressure on actuator operation

C. Troubleshooting sequence
   1) Describe two ways of determining the problem with a malfunctioning hydraulic system
   2) Given the fault in a malfunctioning hydraulic system, describe the component relationships
   3) Make a list of possible causes for the malfunctioning of the given system
   4) Given the specifications of a hydraulic system, compare them to actual or hypothetical measurements

5) Given a malfunctioning hydraulic system, following a logical troubleshooting sequence, trace the problem to its origin

Fluid Power System Maintenance and Safety 1

A. Maintenance

1) List three general requirements for a good maintenance program

2) In addition to a proper set of mechanics tools and gauges, list two other factors which are considered "tools" for good maintenance

3) List at least three types of records used to insure proper preventive maintenance

B. Safety

1) List five safety rules for the operator of fluid power machinery

2) List five safety rules for the fluid power mechanic

Major Exams and Critiques 6

Total Lecture Hours 36

LAB OUTLINE:

Lab Topics	Contact Hrs.
The Fundamental Hydraulic Circuit This exercise establishes a common base for discussion of hydraulic systems by providing the student the opportunity to: A. Identify hydraulic components B. Assemble components into a hydraulic circuit C. Adjust valve settings D. Operate a basic circuit E. Test circuit operation	3
Basic Physical Laws Pressure and flow relationships are introduced and demonstrated under flow and non-flow (Pascal's Law) conditions	3
Pressure and Force Pressure and force relationships are illustrated by: A. Demonstration of pressure, force, area relationships	3

B. Causes of pressure, units of measurement, measuring instruments
C. Concept of the "hydraulic lever
D. Cylinder load and working pressure relationships

Flow Rate and Velocity 3

Relationships between flow rate and actuator speed, creation of flow in the system, calculation and measurement of flow, actuator speed, and cylinder extension times are examined and demonstrated

Work, Power and Horsepower 3

Definitions of work and power, relationships between pressure and flow to produce power, demonstration and calculations using formulas, and concepts of efficiency are examined

Properties of Hydraulic Fluids and **Fluid Storage Conditioning** 3

A combined lab exercise of activity 6 and 9 to illustrate:

A. Effect of temperature change on viscosity
B. Relationship of viscosity and resistance to flow through hydraulic lines, valves, and fitting
C. Characteristics of a well designed reservoir
D. Importance of proper fluid conditioning

Fluid Power Symbols 3

The introduction of graphic symbols used in industrial diagrams. (Previous introductory labs used pictorial symbols as a training aid.) Basic symbols for components are studied and practiced by interpreting and sketching simple hydraulic circuits

Hydraulic Pumps 3

The concept of pumps displacement and its relationship to output flow, volumetric efficiency, and the effects of temperature are demonstrated

Fluid Transmission and Introduction to Control Valves 3

A combined lab of Activity 10 and 11 to illustrate:

A. Hydraulic conductors, terminology, design features, sizing, and selection are demonstrated
B. Pressure, flow, and directional controls are introduced and demonstrated

Pressure Control Valves 3

Design features and function of pressure controls are discussed. Definition of terms and testing of a pilot-operated relief valve, to include plotting of

test results, demonstrates valve operation (Activity 12)	
Directional Control Valves	3
Design features, terminology, and valve configurations are demonstrated and discussed (Activity 13)	
Flow Control Valves	3
Valve ratings and concepts of compensation are discussed and pressure compensation is demonstrated in the lab exercise (Activity 14)	
Total Lab Hours	**36**

COURSE OBJECTIVES: TECHNICAL COMPETENCIES

After the successful completion of this course the student will be able to:

A. PRACTICE SAFETY

1. Follow Safety Manuals and All Safety Regulations/Requirements
   a. Assume responsibility for the personal safety of oneself and others
   b. Develop a personal attitude towards safety
   c. Interpret safety manual directives
   d. Comply with established company safety practices
   e. Complete forms/paperwork as required
2. Use Protective Equipment
   a. Wear protective safety clothing as required
   b. Maintain and use protective guards and equipment on machinery
   c. Locate and properly use protective equipment
   d. Use lifting aids when necessary
3. Follow Safe Operating Procedures for Hand and Machine Tools
   a. Identify and understand safe machine operating procedures
   b. Demonstrate safe machine operation
4. Maintain a Clean and Safe Work Environment
   a. Keep work areas clean
   b. Clean machine/hand tools when work is completed
   c. Put tools away when work is finished
   d. Keep aisles clear of equipment and materials
   e. Perform preventative maintenance as required
5. Control Fire Hazards
   a. Handle/store flammable materials appropriately
   b. Use electricity correctly (e.g., defective outlets, frayed cords, "burning" odor)
   c. Prevent spontaneous ignition by practicing proper waste disposal habits
   d. Keep marked aisles clear of equipment and materials
   e. Interpret/display MSDS sheets as required
   f. Identify fire exits and fire-fighting equipment

B. APPLY MATHEMATICAL CONCEPTS

1. Perform Basic Arithmetic Functions

a. Add, subtract, multiply and divide whole numbers
b. Add, subtract, multiply, and divide fractions
c. Add, subtract, multiply, and divide decimals

2. Interconvert Fractions/Decimals
   a. Convert fractions to decimal equivalents
   b. Convert decimal values to nearest fractional equivalent
3. Interconvert Metric/English Measurements
   a. Convert English dimensions to Metric
   b. Convert Metric dimensions to English
4. Use all Functions on a Scientific Calculator
   a. Apply all trigonometric functions
   b. Apply all algebraic functions
   c. Apply all statistical functions

C. MAINTAIN HYDRAULIC/PNEUMATIC DEVICES

1. Use Test Equipment
   a. Monitor hydraulic flow with flow meters
   b. Use temperature gauges to determine hydraulic fluid operating temperature
   c. Use flow control valves, U-tube manometers and pressure gauges to measure operating conditions for the fluid power system
2. Describe Basic Principles of Hydraulic Systems
   a. List advantages of hydraulic systems
   b. Identify components of typical hydraulic system
   c. State or describe Pascal's law
   d. Analyze a hydraulic system to determine its performance
3. Identify Hydraulic Fluids
   a. Name types of hydraulic fluids
   b. List methods of measuring fluid viscosity
   c. List desirable characteristics of hydraulic fluids
   d. Identify safety hazards related to hydraulic fluid use
   e. Discuss heat exchangers, filters, and micron rating of filters
4. Recommend Power Distribution and Sealing Devices
   a. Describe proper identification and selection of lines, hoses, and fittings
   b. Discuss pressure, velocity, and safety factors
   c. List conditions determining selection of sealing devices
5. Recognize Pumps, Actuators, and Hydraulic Control Devices
   a. Name general classifications of pumps
   b. Determine overall pump efficiency
   c. Name types of positive displacement pumps and give advantages and disadvantages of each
   d. Discuss types of variable delivery pumps and describe their operation
   e. Describe linear actuators (cylinders)
   f. Describe how cylinders are rated and sized
   g. Describe rotary actuators and motors
   h. Name two types of hydraulic motors
6. Troubleshoot Hydraulic/Pneumatic Systems
   a. Discuss common methods of troubleshooting hydraulic systems
   b. Follow a logical troubleshooting sequence to trace a problem to its origin

COURSE OBJECTIVES: SCANS COMPETENCIES

The Secretary's Commission on Achieving Necessary Skills (SCANS), U.S. Department of Labor, has identified in its "AMERICA 2000 REPORT" that all students should develop a new set of competencies and foundation skills if they are to enjoy a productive, full and satisfying life. These are in addition to the Technical Workplace Competencies required by industry. SCANS is made up of five competencies and a three-part foundation of skills and personal qualities that are needed for solid job performance.

The following activities will be performed by each student for successful completion of this course:

I. **COMPETENCIES**

- *A.* ***Resources:*** *Identifies, organizes, plans, and allocates resources*
  1. follows a schedule to complete assigned tasks on time
  2. provide a self-evaluation of performance based on the time and quality of work
- *B.* ***Interpersonal:*** *Works with others*
  1. complete assigned responsibilities within the lab serving as a member of the team
  2. provide individual assistance/direction to peers as requested
  3. works well with all members of the class
- *C.* ***Information:*** *Acquires and uses information*
  1. read and interpret schematics and flowcharts
- *D.* ***Systems:*** *Understands complex inter-relationships*
  1. demonstrate knowledge of the following systems:
     a. laboratory organization structure: physical and social
     b. organization of personnel and facilities in the lab
     c. systematic organization of training materials
  2. monitors and corrects performance during
     a. adjustments of individual laboratory work schedule
     b. constantly evaluating the quality of work to achieve acceptable standards
     c. maintains record of evaluations and sets individual goals
- *E.* ***Technology:*** *Works with a variety of technologies*
  1. maintains and troubleshoots equipment
     a. applies appropriate preventative maintenance
     b. when operating equipment
     c. reports all malfunctions of equipment to supervisor/instructor
     d. perform clean-up assignments of lab at the end of the class

II. **FOUNDATION SKILLS**

- *A.* ***Basic Skills:*** *Reads, writes, performs arithmetic and mathematical operations, listens and speaks.*

1. ***Reading:*** *Locates, understands, and interprets written information in prose and in documents such as manuals, graphs, and schedules*
   a. studies student laboratory manual
   b. interprets blueprints and technical drawings
   c. read/studies textbook
   d. follow a daily laboratory schedule to maintain appropriate time-line and product completion
2. ***Writing:*** *Communicates thoughts, ideas, information, and messages in writing; and creates documents such as letters, directions, manuals, reports, graphs, and flow charts*
   a. maintain a lecture notebook
   b. submit written responses to chapter question assignments
   c. complete all written assignments
3. ***Arithmetic/Mathematics:*** *Perform basic computations and approaches practical problems by choosing appropriately from a variety of mathematical techniques*
   a. keeps a running computation of individual grade
   b. interconverts fractions to decimal expressions
4. ***Listening:*** *Receives, attends to, interprets, and responds to verbal messages and other cues*
   a. assimilate classroom instruction
   b. interpret and assimilate video instruction
   c. observe laboratory demonstrations
   d. seek and receive individualized instruction in the laboratory
5. ***Speaking:*** *Organizes ideas and communicates orally*
   a. participates in classroom discussions
   b. organize ideas and communicate specific questions to the instructor
   c. verbally affirms understanding of a concept, procedure, or required skill
   d. communicates with peers to ensure the smooth and safe operation of the laboratory

B. ***Thinking Skills:*** *Thinks creatively, makes decisions, solves problems, visualizes, knows how to learn and reasons.*
1. ***Decision Making:*** *Specifies goals and constraints, generates alternatives, considers risks, and evaluates and chooses best alternative*
   a. identifies personal goals
   b. identifies actions required to accomplish personal goals
2. ***Problem Solving:*** *Recognizes problems and devises and implements plan of action*
   a. makes daily accommodations to stay on schedule
   b. seeks additional instruction/clarification for assignment completion
   c. balances social and academic life/responsibilities
   d. accepts responsibility
3. ***Seeing Things In the Mind's Eye:*** *Organizes, and processes symbols, pictures, graphs, objects, and other information*
   a. interprets technical drawings
   b. interprets technical illustrations and symbols

c. understands both written and verbal instructions
d. assimilates process during instructor demonstrations

4. ***Knowing How to Learn:*** *Use efficient learning techniques to acquire and apply new knowledge and skills*
   a. demonstrate mastery of the basic skills and techniques
   b. use these sequential skills to support mastery of new skills
   c. understand the sequential nature of acquired skills and the subsequent knowledge application of new skills and techniques
5. ***Reasoning:*** *Discovers a rule or principle underlying the relationship between two or more objects and applies it when solving a problem*
   a. understands that practice may not make it perfect but it certainly will improve the skill of the technician

C. ***Personal Qualities:*** *Displays responsibility, self-esteem, sociability, self-management, and integrity and honesty.*

1. ***Responsibility:*** *Exerts a high level of effort and perseveres towards goal attainment*
   a. develops an understanding that in order to be successful you must be a "good" student
   b. develops an understanding that a "good" student is the one who is prompt to every class and has prepared for the day's work
   c. develops an understanding good students know what they are going to do in class and does not waste time
   d. develops a fine work-ethic
2. ***Self-Esteem:*** *Believes in own self-worth and maintains a positive view of self*
   a. learns to take pride in his or her work through positive reinforcement
   b. sees himself or herself as an asset to the class through continued contributions to the group and a shared common goal
   c. understands that an individual with a positive attitude and the belief in their own abilities will systematically seek solutions and be a valuable employee
3. ***Sociability:*** *Demonstrates understanding, friendliness, adaptability, empathy, and politeness in group settings*
   a. assist classmates in improving technical skills
   b. assist students with special needs as a peer mentor
   c. share laboratory resources (machines, tools and instructor's individual attention)
4. ***Self-Management:*** *Assesses self accurately, sets personal goals, monitors progress, and exhibits self-control*
   a. maintain a record of academic achievement (individual gradebook)
   b. make accommodations to laboratory schedules due to broken machines/tools
   c. accept the responsibility for self-management
5. ***Integrity/Honesty:*** *Chooses ethical courses of action*
   a. accept the responsibility for own actions
   b. exhibit personal honesty at all times

c. accept the challenge of doing your own work in the laboratory, during examination, and on outside assignments
d. understand the consequences of unethical behaviors

Appropriate Reference Materials:

*M*achine Tool *A*dvanced *S*kills
*T*echnology Program

MAST

COURSE SYLLABUS

ELECTRICAL APPLICATIONS

121

MAST PROGRAM
COURSE SYLLABUS
ELECTRICAL APPLICATIONS

Lecture hours/week: 3 **Lab hours/week: 3** **Credit hours: 4**

COURSE DESCRIPTION:

A survey course designed to present basic concepts in DC and AC circuits, fundamental motor design and applications, and basic motor controls, including analyzing, calculating, and measuring DC and AC voltage, current, and resistance.

PREREQUISITES: **NONE**

REQUIRED COURSE MATERIALS:

Textbook: Delmar's Standard Textbook of Electricity, Stephen L. Herman, Delmar Publishers, Inc., latest edition.

Lab Manual: **NONE**

Hand Tools/Quantity Required:

Notebook paper (50 sheets)
Binder
Scientific calculator
Test leads with alligator clips (12 minimum)
Screwdriver - 6 inch long, 3/16 inch straight blade
Screwdriver - #2 Phillips
Safety glasses

METHODS OF INSTRUCTION:

Lecture: Didactic presentations will include lecture, video and demonstrations.

Laboratory: Laboratory will include presentation of basic concepts in DC and AC circuits, including analyzing, calculating, and measuring DC and AC voltage, current, and resistance, as well as fundamental motor design, applications and controls.

Method of Evaluation: A student's grade will be based on multiple measures of performance. The assessment will measure development of independent critical thinking skills and will include evaluation of the student's ability to:

1. perform the manipulative skills of the craft as required to satisfactorily complete laboratory assignments

2. satisfactorily perform on written, oral, and practical examinations
3. follow safe practices in using electricity
4. analyze atomic structure and the proportionalism that makes an atom a good conductor
5. analyze electrical quantities in circuits, including voltage, current, resistance, and power
6. analyze series and parallel DC circuits using Ohm's law and Kirchoff's voltage and current laws
7. analyze complex DC circuits using Ohm's law and Kirchoff's voltage and current laws
8. relate the principles of magnetism and inductance to electrical circuits
9. satisfactorily perform on outside assignments including writing assignments
10. contribute to class discussions
11. maintain attendance per current policy
12. follow all shop rules and safety regulations as stated in the laboratory manual

LECTURE OUTLINE:

	Lecture Topics	Text Reference Page	Contact Hrs.
Unit 1	**Introduction to Electricity**		4
1.01	Define atoms, protons, electrons, charge, voltage, current, resistance, power, electricity, etc.		
1.02	Decode the colors of a carbon resistor		
1.03	Apply Ohm's law		
Unit 2	**Series Circuits**		4
2.01	Define a series circuit		
2.02	Apply Ohm's law and Kirchoff's voltage law to a series circuit		
2.03	Evaluate a simple circuit to determine if it is a series circuit		
Unit 3	**Parallel Circuits**		4
3.01	Define a parallel circuit		
3.02	Apply Ohm's law and Kirchoff's law to a parallel circuit		
3.03	Evaluate a simple circuit to determine if it is a parallel circuit		
Unit 4	**Complex DC Circuits**		4
4.01	Analyze a circuit to establish a circuit arrangement		
4.01a	What is series?		
4.01b	What is parallel?		
4.02	Apply series/parallel parameters to circuit		
4.03	Apply Ohm's law and Kirchoff's current voltage law to the circuit		

UNIT 5	**Magnetism and Inductance**	4
5.01	Define magnetism and inductance	
5.02	Relate the effects of magnetism and inductance to AC devices	
5.03	Define impedance, inductive reactance and capacitive reactance	
UNIT 6	**AC Circuits**	4
6.01	Define alternating current	
6.02	List examples of AC signals	
6.03	Illustrate the generation of a sinewave	
6.04	Define terms relating to AC signals	
6.04a	Peak values	
6.04b	RMS values	
6.04c	Instantaneous values	
6.04d	Frequency	
6.04e	Period	
6.04f	Cycle	
6.04g	Hertz	
UNIT 7	**Inductance and Capacitance**	4
7.01	Define inductance and capacitance	
7.02	Relate the effects of inductance and capacitance to AC circuits and motors	
UNIT 8	**Relays**	4
8.01	Define relay construction and the principle of operation	
8.02	List the different types of relays	
UNIT 9	**Transformers**	4
9.01	Define transformer construction and the principle of operation	
9.02	List the different types of transformers	
	Total Lecture Hours	**36**

LAB OUTLINE:

	Lab Topics	Contact Hrs.
Unit 1	**Safety and Orientation**	2
1.01	Review lab safety	
1.02	Demonstrate uses of analog volt-ohm-milliamp meter	
Unit 2	**Resistance**	3
2.01	Practice decoding color bands of a carbon resistor	
2.02	Demonstrate resistance measuring function of analog	

	meter	
2.03	Measure carbon resistors	
2.04	Calculate percent error of resistor; coded value versus measured value	
Unit 3	**Voltage**	**4**
3.01	Demonstrate voltage measuring function of analog meter	
3.02	Measure voltage output of series-aiding, series-opposing, parallel and series-parallel battery groupings	
3.03	Compare the advantages and disadvantages of power supplies and battery sources	
Unit 4	**Current**	**3**
4.01	Demonstrate the current measuring function of an analog meter	
4.02	Measure current in a variety of simple circuits	
Unit 5	**Power**	**3**
5.01	Demonstrate the use of a wattmeter to measure power in a simple DC circuit	
5.02	Measure power in a circuit	
5.03	Confirm the validity of power formulas by measurements of power in a circuit	
Unit 6	**Series Circuits**	**4**
6.01	Build a simple series circuit	
6.02	Analyze a series circuit	
Unit 7	**Parallel Circuits**	**4**
7.01	Build a simple parallel circuit	
7.02	Confirm the four parameters that govern a parallel circuit	
7.03	Troubleshoot a parallel circuit	
Unit 8	**Complex (Series/Parallel) Circuits**	**4**
8.01	Build a complex circuit	
8.02	Analyze a complex circuit	
Unit 9	**Magnetism**	**3**
9.01	Analyze the properties of permanent magnets	
9.02	Observe and analyze the operation and properties of electromagnets	
Unit 10	**Magnetic Induction**	**3**
10.01	Analyze the properties of magnetic induction	
10.02	Observe magnetic induction in operation	
Unit 11	**AC Signals**	**3**
11.01	Observe AC signals of various waveshapes and frequencies on an oscilloscope	
11.02	Compare peak values on oscilloscope with RMS values of analog meter	
11.03	Measure voltage with analog volt-ohm-milliamp meter	—
	Total Lab Hours	**36**

COURSE OBJECTIVES: TECHNICAL COMPETENCIES

After the successful completion of this course the student will be able to:

A. PRACTICE SAFETY

1. Follow Safety Manuals and All Safety Regulations/Requirements
   a. Assume responsibility for the personal safety of oneself and others
   b. Develop a personal attitude towards safety
   c. Interpret safety manual directives
   d. Comply with established company safety practices
   e. Complete forms/paperwork as required
2. Use Protective Equipment
   a. Wear protective safety clothing as required
   b. Maintain and use protective guards and equipment on machinery
   c. Locate and properly use protective equipment
   d. Use lifting aids when necessary
3. Maintain a Clean and Safe Work Environment
   a. Keep work areas clean
   b. Clean machine/hand tools when work is completed
   c. Put tools away when work is finished
   d. Keep aisles clear of equipment and materials
   e. Perform preventative maintenance as required
4. Control Fire Hazards
   a. Handle/store flammable materials appropriately
   b. Use electricity correctly (e.g., defective outlets, frayed cords, "burning" odor)
   c. Keep marked aisles clear of equipment and materials
   d. Interpret/display MSDS sheets as required

B. MAINTAIN ELECTRICAL DEVICES

1. Use Electrical Test Equipment
   a. Measure resistance with an analog volt-ohm-milliamp meter
   b. Measure voltage with volt-ohm-milliamp meter
   c. Measure current with volt-ohm milliamp meter
   d. Use wattmeter to measure power in a simple DC circuit
   e. Use oscilloscope to observe AC signals of various waveshapes and frequencies
2. Apply Specific Terms to Electrical Circuits
   a. Define voltage, current, and resistance
   b. Discuss power, power factor, and sine waves
   c. Define three phase, induction, and capacitance
3. Analyze Series, Parallel and Complex DC/AC Circuits
   a. Define a series circuit
   b. Define a parallel circuit
   c. Define a complex DC circuit
   d. Define an AC circuit
   e. Apply Ohm's law to each of the above circuits
   f. Apply Kirchoff's law to each of the above circuits

4. Check AC and DC Motors
   a. List types of AC and DC motors
   b. List characteristics of AC motors
   c. List characteristics of DC motors
   d. Compare AC motors versus DC motors to job duty
5. Inspect Transformers and Generators
   a. Define transformer construction and the principle of operation
   b. List the different types of transformers
   c. Define electro-magnetic induction
   d. Describe the principle of operation of AC alternators and DC generators
6. Troubleshoot Electrical Devices
   a. Discuss common methods of troubleshooting electrical systems
   b. Follow a logical troubleshooting sequence to trace a problem to its origin

COURSE OBJECTIVES: SCANS COMPETENCIES

The Secretary's Commission on Achieving Necessary Skills (SCANS), U.S. Department of Labor, has identified in its "AMERICA 2000 REPORT" that all students should develop a new set of competencies and foundation skills if they are to enjoy a productive, full and satisfying life. These are in addition to the Technical Workplace Competencies required by industry. SCANS is made up of five competencies and a three-part foundation of skills and personal qualities that are needed for solid job performance.

The following activities will be performed by each student for successful completion of this course:

I. **COMPETENCIES**

A. ***Resources:*** *Identifies, organizes, plans, and allocates resources*
   1. follows a schedule to complete assigned tasks on time
   2. provide a self-evaluation of performance based on the time and quality of work

B. ***Interpersonal:*** *Works with others*
   1. complete assigned responsibilities within the lab serving as a member of the team
   2. provide individual assistance/direction to peers as requested
   3. works well with all members of the class

C. ***Information:*** *Acquires and uses information*
   1. read and interpret schematics
   2. organize and apply theories of electrical applications

D. ***Systems:*** *Understands complex inter-relationships*
   1. demonstrate knowledge of the following systems:
      a. laboratory organization structure: physical and social
      b. organization of personnel and facilities on the shop floor
      c. systematic organization of training materials

2. monitors and corrects performance during
   a. adjustments of individual laboratory work schedule
   b. constantly evaluating the quality of work to achieve acceptable standards
   c. maintains record of evaluations and sets individual goals

E. Technology: Works with a variety of technologies

1. chooses procedure, tools and equipment required to prepare/check a circuit
2. maintains and troubleshoots equipment
   a. applies appropriate preventative maintenance
   b. reports all malfunctions of equipment to supervisor/instructor
   c. perform clean-up assignments of laboratory at the end of the class period

II. FOUNDATION SKILLS

*A. **Basic Skills:** Reads, writes, performs arithmetic and mathematical operations, listens and speaks.*

*1. **Reading:** Locates, understands, and interprets written information in prose and in documents such as manuals, graphs, and schedules*
   a. studies student laboratory assignment sheets
   b. read/studies textbook
   c. follow a daily laboratory schedule to maintain appropriate time-line and project completion

*2. **Writing:** Communicates thoughts, ideas, information, and messages in writing; and creates documents such as letters, directions, manuals, reports, graphs, and flow charts*
   a. outline the steps necessary to produce a build/test a simple circuit
   b. maintain a lecture notebook
   c. submit written responses to chapter question assignments
   d. complete all written assignments

*3. **Arithmetic/Mathematics:** Perform basic computations and approaches practical problems by choosing appropriately from a variety of mathematical techniques*
   a. determines appropriate test parameters and variables
   b. calculates voltage, current and resistance

*4. **Listening:** Receives, attends to, interprets, and responds to verbal messages and other cues*
   a. assimilate classroom instruction
   b. interpret and assimilate video instruction
   c. observe laboratory demonstrations
   d. seek and receive individualized instruction in the laboratory

*5. **Speaking:** Organizes ideas and communicates orally*
   a. participates in classroom discussions
   b. organize ideas and communicate specific questions to the instructor
   c. verbally affirms understanding of a concept, procedure, or required skill

d. communicates with peers to ensure the smooth and safe operation of the laboratory

B. ***Thinking Skills:*** *Thinks creatively, makes decisions, solves problems, visualizes, knows how to learn and reasons.*

1. ***Decision Making:*** *Specifies goals and constraints, generates alternatives, considers risks, and evaluates and chooses best alternative*
   a. identifies personal goals
   b. identifies actions required to accomplish personal goals
2. ***Problem Solving:*** *Recognizes problems and devises and implements plan of action*
   a. makes daily accommodations to stay on schedule
   b. seeks additional instruction/clarification for assignment completion
   c. balances social and academic life/responsibilities
   d. accepts responsibility
3. ***Seeing Things In the Mind's Eye:*** *Organizes, and processes symbols, pictures, graphs, objects, and other information*
   a. interprets technical drawings
   b. interprets technical illustrations and symbols
   c. understands both written and verbal instructions
   d. assimilates process during instructor demonstrations
4. ***Knowing How to Learn:*** *Use efficient learning techniques to acquire and apply new knowledge and skills*
   a. demonstrate mastery of the basic skills and techniques
   b. use these sequential skills to support mastery of new skills
   c. understand the sequential nature of acquired skills and the subsequent knowledge application of new skills and techniques
5. ***Reasoning:*** *Discovers a rule or principle underlying the relationship between two or more objects and applies it when solving a problem*
   a. understands that practice may not make it perfect but it certainly will improve the skill of the technician
   b. understands that the quality of the product is a function of the time of the operation and the attitude and skill of the technician

C. ***Personal Qualities:*** *Displays responsibility, self-esteem, sociability, self-management, and integrity and honesty.*

1. ***Responsibility:*** *Exerts a high level of effort and perseveres towards goal attainment*
   a. develops an understanding that in order to be successful you must be a "good" student
   b. develops an understanding that a "good" student is the one who is prompt to every class and has prepared for the day's work
   c. develops an understanding good students know what they are going to do in class and does not waste time
   d. develops a fine work-ethic
2. ***Self-Esteem:*** *Believes in own self-worth and maintains a positive view of self*

a. learns to take pride in his or her work through positive reinforcement
b. sees himself or herself as an asset to the class through continued contributions to the group and a shared common goal
c. understands that an individual with a positive attitude and the belief in their own abilities will systematically seek solutions and be a valuable employee

3. ***Sociability:*** *Demonstrates understanding, friendliness, adaptability, empathy, and politeness in group settings*
   a. assist classmates in improving technical skills
   b. assist students with special needs as a peer mentor
   c. share laboratory resources (test equipment, tools and instructor's individual attention)
4. ***Self-Management:*** *Assesses self accurately, sets personal goals, monitors progress, and exhibits self-control*
   a. maintain a record of academic achievement (individual grade book)
   b. accept the responsibility for self-management
5. ***Integrity/Honesty:*** *Chooses ethical courses of action*
   a. accept the responsibility for own actions
   b. exhibit personal honesty at all times
   c. accept the challenge of doing your own work in the laboratory, during examination, and on outside assignments
   d. understand the consequences of unethical behaviors

Appropriate Reference Materials:

*M*achine Tool *A*dvanced *S*kills
*T*echnology Program

MAST

COURSE SYLLABUS

SURVEY OF WELDING PROCESSES AND APPLICATIONS

131

MAST PROGRAM
COURSE SYLLABUS
SURVEY OF WELDING PROCESSES AND APPLICATIONS

Lecture hours/week: 3 **Lab hours/week: 3** **Credit hours: 4**

COURSE DESCRIPTION:

This course is a survey of shielded metal arc, gas tungsten arc, gas metal arc, flux cored arc, and submerged arc welding processes. Metal weldability and weld symbols are considered. Process safety, electrode selection, and process parameters are emphasized. Hard surfacing, using shielded metal arc and oxyacetylene processes and techniques are studied.

PREREQUISITES: **NONE**

REQUIRED COURSE MATERIALS:

Textbook: Oxy-Acetylene Handbook, by Linde, Union Carbide Publisher, Latest Edition
New Lessons in Arc Welding, by Lincoln Electric, Lincoln Electric Publisher, Latest Edition

Lab Manual: None Required

Student Tool List	**Qty. Req'd.**
Oxy-acetylene cutting and welding goggles (mono) with #5 filter lens and one clear plastic lens	1 pair
Friction lighter	1
Wire brush 1" wide with long handle	1
Soap stone	2 pieces
Welder's cap	1
Welding gloves, long gauntlet	1 pair
Chipping hammer	1
Safety glasses	1 pair
Slip joint pliers	1 pair

METHODS OF INSTRUCTION:

Lecture: Didactic presentations will include lecture, video, and demonstrations.

Laboratory: Hands on laboratory activities to enable the students to learn the various aspects of the welding process.

Method of Evaluation: A student's grade will be based on multiple measures of performance. The assessment will measure development of independent critical thinking skills and will include evaluation of the student's ability to:

1. perform the manipulative skills of the craft as required to satisfactorily complete laboratory assignments
2. apply theory to laboratory assignments
3. perform on written, oral, or practical examinations
4. perform on outside assignments including writing assignments
5. contribute to class discussions
6. maintain attendance per current policy
7. follow all shop rules and safety regulations as stated in the laboratory manual

LECTURE OUTLINE:

Lecture Topics	Text Reference Page	Contact Hrs.
Introduction to the course		1
Introduction to oxy-acetylene fusion	1	1
Oxy-acetylene welding and cutting	9	2
Introduction to mechanical and physical properties	77	1
Non-fusion welding		1
Introduction to the oxy-acetylene cutting processes		1
Test #1		1
The shielded metal arc welding process	1-7	1
Running a good quality bead in the flat position	1-21	1
Introduction to shielded metal arc welding electrodes	3-3	2
Shielded metal arc power sources	2-3	1
Test #2		1
Weld joints, weld types and weld positions	1-54	2
Introduction to fillet welds	1-56	1
Test #3		1
Introduction to gas metal arc welding and flux core arc welding	7-37	2
Short circuiting metal transfer		1
Test #4		1
Power sources for GMAW and FCAW		1
SMAW and FCAW filler metal transfer modes		1
Test #5		1
Shielding gases used with the GMAW process	7-37	1
Shielding gases used with the FCAW process		1
Test #6		1

Introduction to gas tungsten arc welding		2
Power sources for GTAW		1
GTAW electrodes		1
Test #7		1
Introduction to submerged arc welding and techniques	7-69	1
Submerged arc welding processes		1
Test #8		1
	Total Lecture Hours	36

LAB OUTLINE:

	Lab Topics	Contact Hrs.
1	**The Oxy-Acetylene Welding and Cutting Process**	9
	Demonstration of setting up and break down of equipment	
	A. Welding beads on plate	
	(1) Flat position	
	(2) Without and with filler	
	B. Square butt joints	
	(1) Flat and vertical position	
	(2) With filler material	
	C. Brazing beads on plate	
	(1) Flat position	
	(2) With filler material	
	D. Brazing square butt joint	
	(1) Flat and vertical position	
	(2) With filler	
	E. Oxy-acetylene cutting	
	(1) Cutting to a straight line	
2	**The Shielded Metal Arc Welding Process (SMAW)**	9
	A. Welding beads on plate	
	(1) E6010, E6011 and/or E7018 dependent on availability	
	(2) Flat, horizontal and vertical	
	B. Welding tee joint	
	(1) E6010, E6011 and/or E7018 dependent on availability	
	(2) Flat, horizontal and vertical	
3	**The Gas Metal Arc Welding and Flux Core Welding Processes (GMAW)**	6
	A. Set up 3 machines each process	
	B. Welding beads on plate, both processes	
	(1) Have hands on with observers at each station	
	C. Demonstration of GMAW spot welder	
4	**The Gas Tungsten Arc Welding Process (GTAW)**	6
	A. Set up machines for welding steel and aluminum (2 or 3 each)	
	B. Welding beads on plate steel	
	(1) Have hands on with observers	
	C. Welding bead on plate aluminum	

(2) Have hands on with observers

5	**The Submerged Arc Welding Process**	6
	A. Demonstrate beads on plate	
	B. Demonstrate running beads roll position	
	C. Let students have hands on and observation	
	Total Lab Hours	36

COURSE OBJECTIVES: TECHNICAL COMPETENCIES

After the successful completion of this course the student will be able to:

A. PRACTICE SAFETY

1. Use Protective Equipment
   a. Wear protective safety clothing as required when welding
2. Follow Safe Operating Procedures for Welding/Cutting Machines
   a. Identify and understand safe welding procedures
   b. Demonstrate safe welding procedures

B. PERFORM WELDING OPERATIONS

1. Weld With Shielded Metal Arc Welding (SMAW) Process
   a. Identify factors for welding electrode selection
   b. Adjust welding amperage setting for each application
   c. Demonstrate proper use of safety equipment
   d. Weld beads on plate (flat and horizontal)
   e. Weld tee joints (flat and horizontal)
   f. Identify weld inspection factors and techniques
2. Weld/Cut With Oxy-acetylene
   a. Setup and break down the oxy-acetylene welding/cutting station
   b. Properly adjust oxy-acetylene regulators
   c. Identify factors that determine torch welding and cutting tip selection
   d. Demonstrate routine torch maintenance procedures
   e. Weld beads on plate (with and without filler) in the flat and horizontal positions
   f. Weld square groove butt joints in the flat and horizontal positions
   g. Braze weld beads on plate in the flat position
   h. Make square cuts to a straight line with the cutting torch
   i. Demonstrate proper use of safety equipment
3. Weld With Gas Tungsten Arc Welding (GTAW) (Heliarc)
   a. Set up GTAW welder for welding steel
   b. Set up GTAW welder for welding aluminum
   c. Weld beads on plate (steel) with appropriate filler rod in the flat position
   d. Weld beads on plate (aluminum) with appropriate filler rod in the flat position
   e. Weld lap joints in the horizontal position on steel plate
   f. Weld lap joints in the horizontal position on aluminum plate
4. Weld With Gas Metal Arc Welding (GMAW)/(MIG)
   a. Set up machine for gas metal arc welding

b. Set up machine for flux cored arc welding
c. Weld beads on plate with gas metal arc welding system in the flat position
d. Weld beads on plate with flux cored welding system in the flat position
e. Weld lap joints on steel plate with the gas metal arc welding system in the horizontal position
f. Weld lap joints on steel plate with the flux cored arc welding system in the horizontal position

COURSE OBJECTIVES: SCANS COMPETENCIES

The Secretary's Commission on Achieving Necessary Skills (SCANS), U.S. Department of Labor, has identified in its "AMERICA 2000 REPORT" that all students should develop a new set of competencies and foundation skills if they are to enjoy a productive, full and satisfying life. These are in addition to the Technical Workplace Competencies required by industry. SCANS is made up of five competencies and a three-part foundation of skills and personal qualities that are needed for solid job performance.

The following activities will be performed by each student for successful completion of this course:

I. COMPETENCIES

A. Resources: Identifies, organizes, plans, and allocates resources
1. follows a schedule to complete assigned tasks on time
2. follows a schedule to maximize laboratory resources
3. complete a tool crib request form for required materials and supplies

B. Interpersonal: Works with others
1. complete assigned responsibilities within the welding lab serving as a member of the team
2. provide individual assistance/direction to peers as requested
3. works well with all members of the class

C. Information: Acquires and uses information
1. read and interpret weld symbols
2. organize and apply theories of welding and cutting

D. Systems: Understands complex inter-relationships
1. demonstrate knowledge of the following systems:
   a. organization of personnel and facilities on the shop floor
   b. systematic approach to the cutting and welding processes
   c. welding rod classification and match to various metals
   d. systematic organization of training materials
2. monitors and corrects performance during
   a. the welding process
   b. adjustments of individual laboratory work schedule
   c. constantly evaluating the quality of work to achieve acceptable standards

E. ***Technology:*** *Works with a variety of technologies*

1. chooses procedure, tools and equipment required to perform the welding process
2. applies appropriate procedures and uses appropriate tools and equipment to produce a weld to acceptable standards
3. maintains and troubleshoots equipment
   a. applies appropriate preventative maintenance
   b. when using equipment
   c. reports all malfunctions of equipment to supervisor/instructor

II. FOUNDATION SKILLS

A. ***Basic Skills:*** *Reads, writes, performs arithmetic and mathematical operations, listens and speaks.*

1. ***Reading:*** *Locates, understands, and interprets written information in prose and in documents such as manuals, graphs, and schedules*
   a. read/studies textbook
   b. studies student laboratory manual
   c. interprets welding symbols
   d. follow a daily laboratory schedule to maintain appropriate time-line and product completion
2. ***Writing:*** *Communicates thoughts, ideas, information, and messages in writing; and creates documents such as letters, directions, manuals, reports, graphs, and flow charts*
   a. outline the steps necessary to set up, properly adjust and weld/cut using different types of welding equipment
   b. maintain a lecture notebook
3. ***Arithmetic/Mathematics:*** *Perform basic computations and approaches practical problems by choosing appropriately from a variety of mathematical techniques*
   a. keeps a running computation of individual grade
4. ***Listening:*** *Receives, attends to, interprets, and responds to verbal messages and other cues*
   a. assimilate classroom instruction
   b. interpret and assimilate video instruction
   c. observe and assimilate laboratory demonstrations
   d. seek and receive individualized instruction in the laboratory
   e. practices active listening by affirming understanding of verbal instructions, asking questions for clarification and probing for specifics
5. ***Speaking:*** *Organizes ideas and communicates orally*
   a. participates in classroom discussions
   b. organize ideas and communicate specific questions to the instructor
   c. verbally affirms understanding of a concept, procedure, or required skill
   d. communicate with peers, instructors and supervisors to ensure the smooth and safe operation of the laboratory

B. ***Thinking Skills:*** *Thinks creatively, makes decisions, solves problems, visualizes, knows how to learn and reasons.*

1. ***Decision Making:*** *Specifies goals and constraints, generates alternatives, considers risks, and evaluates and chooses best alternative*
   a. analyzes requirements and makes decisions to select appropriate welding process, equipment, materials, fixturing, and protective equipment
   b. prioritizes activities for effective use of time
2. ***Problem Solving:*** *Recognizes problems and devises and implements plan of action*
   a. makes daily accommodations to stay on schedule
   b. seeks additional instruction/clarification for assignment completion
   c. troubleshoots welding problems and makes process adjustments to correct
3. ***Seeing Things In the Mind's Eye:*** *Organizes, and processes symbols, pictures, graphs, objects, and other information*
   a. visualize process during instructor lecture
   b. visualize the relative motions between welding rod and workpiece to generate desired weld patterns and weld strength as required
4. ***Knowing How to Learn:*** *Use efficient learning techniques to acquire and apply new knowledge and skills*
   a. understand that practice will improve skill
   b. asks questions or seeks help when uncertain about new skills or knowledge
5. ***Reasoning:*** *Discovers a rule or principle underlying the relationship between two or more objects and applies it when solving a problem*
   a. applies knowledge of material characteristics, job requirements, and welding processes to perform assignments
   b. applies knowledge of material characteristics, job requirements, and welding processes to troubleshoot and/or imporve the welding process

C. ***Personal Qualities:*** *Displays responsibility, self-esteem, sociability, self-management, and integrity and honesty.*

1. ***Responsibility:*** *Exerts a high level of effort and perseveres towards goal attainment*
   a. displays promptness and preparation for the day's work
   b. plans work to use time efficiently
   c. accepts responsibility for mistakes, and takes corrective and preventive actions
   d. takes initiative when needed to gain resources or assistance to complete assignments
2. ***Self-Esteem:*** *Believes in own self-worth and maintains a positive view of self*
   a. takes pride in work through positive reinforcement
   b. sees self as a valued member of the group through continued contributions toward common goals

3. ***Sociability:*** *Demonstrates understanding, friendliness, adaptability, empathy, and politeness in group settings*
   a. assist classmates in improving technical skills
   b. share laboratory resources (welding machines, tools and instructor's individual attention)
4. ***Self-Management:*** *Assesses self accurately, sets personal goals, monitors progress, and exhibits self-control*
   a. perform in-process quality checks on weldments
   b. maintain a record of academic achievement (individual grade book)
   c. accept responsibility for mistakes and infractions, and take steps to resolve or eliminate them
5. ***Integrity/Honesty:*** *Chooses ethical courses of action*
   a. accept the responsibility for own actions
   b. exhibit personal honesty at all times
   c. accept the challenge of doing your own work in the laboratory, during examination, and on outside assignments
   d. understand the consequences of unethical behaviors

Appropriate Reference Materials:

1. Machinery's Handbook, Industrial Press
2. Welding Technology Today, Principles and Practices. Stinchcomb, Craig;: Prentice Hall Inc., New Jersey 1989
3. Welder Handbook. W-100 E-1 Corp., Publication #51077, Nov., 1995
4. Hobart Audio - Visual Training Program
5. Miller Audio - Visual Training Program

WLT 105
01/060696

*M*achine Tool *A*dvanced *S*kills
*T*echnology Program

MAST

COURSE SYLLABUS

CNC MACHINE PROGRAMMING

140

MAST PROGRAM
COURSE SYLLABUS
CNC MACHINE PROGRAMMING

Lecture hours/week: 3 **Lab hours/week: 3** **Credit hours: 4**

COURSE DESCRIPTION:

This course is designed to provide the student with a basic understanding of the programming of CNC machine tools using machine languages to describe machining operations/processes. The course describes the relationship between conventional and CNC machining operations and safety considerations for CNC machining centers. Principles of programming, tooling, setup and machine operations, the Cartesian coordinates system, absolute/incremental modes, word addresses, G & M codes, as well as fixed and canned cycles will be discussed.

PREREQUISITES: **Machine Tool Practices I**

REQUIRED COURSE MATERIALS:

Textbook: Machine Tool Practices, Kibbe, Neely, and Meyer, Wiley Pub., 4th Ed.
Lab Manual: **NONE**

Hand Tools/Quantity Required: Basic tool list for Machine Tool Practices I

METHODS OF INSTRUCTION:

Lecture: Didactic presentations will include lecture, video and demonstrations.

Laboratory: Laboratory will include computer based exercises as well as "hands-on" programming of machining processes and setups on the Fadal milling machine center and the Okuma turning center and other machine control simulators.

Method of Evaluation: A student's grade will be based on multiple measures of performance. The assessment will measure development of independent critical thinking skills and will include evaluation of the student's ability to:

1. perform the manipulative skills of the craft as required to satisfactorily complete laboratory assignments
2. apply theory to laboratory assignments involving cnc machine codes, Cartesian coordinate system, G & M codes, fixed and canned cycles, and the basic skills used to produce a cnc program with SMARTCAM's Job Plan and Edit Plus module
3. satisfactorily perform on written, oral, and practical examinations
4. satisfactorily perform on outside assignments including writing assignments
5. contribute to class discussions
6. maintain attendance per current policy

7. follow all shop rules and safety regulations as stated in the laboratory manual

LECTURE OUTLINE:

	Lecture TopicS	Text Reference Page	Contact Hrs.
Unit 1	**CNC Overview**		**3**
1.01	Description of CNC		
1.02	Job Opportunities in the CNC field		
1.03	Employability Skills in CNC		
1.04	Working Safely with CNC machines		
Unit 2	**The Structure of a CNC System**		**3**
2.01	CNC vs. conventional machining terminology		
2.02	5 Considerations before programming begins		
2.03	Cartesian Coordinate System		
Unit 3	**Process Planning (Mill)**		**3**
3.01	Interpreting a part print		
3.02	Creating a Job Sheet from a part print		
3.03	Introduction to SMARTCAM's Job Plan module		
3.04	Entering information into a Job Plan		
Unit 4	**Programming Format (Mill)**		**3**
4.01	Basic CNC code structure for the FADAL mill		
4.02	Starting a CNC Program		
4.03	Machining examples		
4.04	Ending a CNC program		
4.05	An introduction to SMARTCAM's Edit Plus module and Tape-to Shape		
4.06	Using SMARTCAM to simulate machine tool movements		
UNIT 5	**Programming CNC Machining Operations (Mill)**		**18**
5.01	Straight milling		
5.02	Drilling operations		
5.03	Circular milling		
UNIT 6	**Process Planning (Lathe)**		**3**
6.01	CNC lathe coordinate systems		
6.02	Carbide tooling for CNC lathes		
6.03	Process planning for the CNC lathe		
6.04	Entering tool information into the Job Plan		
UNIT 7	**Programming the CNC Lathe**		**3**

7.01	Basic program structure	
7.02	Turning, Facing, Boring, Drilling and Threading	
	Total Lecture Hours	**36**

LAB OUTLINE:

	Lab Topics	Contact Hrs.
1	**CNC Lab Organization and Safety**	3
2	**Identification of Major CNC Components**	3
3	**CNC (Mill) Tooling Systems**	3
4	**Introduction to SMARTCAM's Programming Software**	6
	a) Job Plan	
	b) Applications	
	c) Edit Plus Modules	
5	**Programming CNC Mills**	9
	a) Basic Program Structure	
	b) Linear Milling, Drilling, Circular Milling and Canned Cycles	
6	**CNC Lathe Tooling Systems**	3
7	**Programming CNC Lathes**	3
8	**Final Project**	6
	Total Lab Hours	**36**

COURSE OBJECTIVES: TECHNICAL COMPETENCIES

After the successful completion of this course the student will be able to:

A. PRACTICE SAFETY

1. Follow Safety Manuals and All Safety Regulations/Requirements
   a. Assume responsibility for the personal safety of oneself and others
   b. Develop a personal attitude towards safety
   c. Interpret safety manual directives
   d. Comply with established company safety practices
2. Use Protective Equipment
   a. Wear protective safety clothing as required
   b. Maintain and use protective guards and equipment on machinery
   c. Locate and properly use protective equipment
   d. Use lifting aids when necessary
3. Follow Safe Operating Procedures for CNC Machine Tools
   a. Identify and understand safe machine operating procedures
   b. Demonstrate safe machine operation
4. Maintain a Clean and Safe Work Environment
   a. Keep work areas clean
   b. Clean machine/hand tools when work is completed
   c. Put tools away when work is finished

d. Keep aisles clear of equipment and materials

B. APPLY MATHEMATICAL CONCEPTS

1. Perform Basic Arithmetic Functions
   a. Add, subtract, multiply and divide whole numbers
   b. Add, subtract, multiply, and divide decimals
2. Interconvert Fractions/Decimals
   a. Convert fractions to decimal equivalents
   b. Convert decimal values to nearest fractional equivalent
   c. Use Decimal Equivalent Chart for conversions
3. Perform Basic Trigonometric Functions
   a. Solve for unknown angles
   b. Solve for unknown sides
4. Calculate Speeds and Feeds for Machining
   a. Calculate RPM for various metals and various tools
   b. Calculate feed for various metals, tools, and depths of cut
5. Locate Machining Points from a Datum Point
   a. Identify points using the Cartesian coordinate system
   b. Identify points using the absolute dimensioning system
   c. Identify points using the incremental dimensioning system

C. INTERPRET ENGINEERING DRAWINGS AND CONTROL DOCUMENTS

1. Review Blueprint Notes and Dimensions
   a. Explain basic blueprint terminology
   b. Identify the types of dimensions
   c. Identify general note symbols
   d. Locate notes on a print
   e. Interpret commonly used abbreviations and terminology
   f. Determine tolerances associated with dimensions on a drawing
   g. Determine the tolerance for a reference dimension
   h. Determine the surface finish for a given part
   i. List the essential components found in the general drawing notes
2. Identify Basic Layout of Drawings
   a. Identify types of lines within a drawing
   b. Identify item number symbols
   c. Identify general note symbols
   d. List the essential components found in the title block
   e. Locate bill of materials in a drawing
   f. List the components found in the revision block
3. Identify Basic Types of Drawings
   a. Identify orthographic views
   b. Identify positions of views (top, front, side, and auxiliary)
   c. Visualize one or more views from a given view
   d. Identify isometric views
   e. Identify exploded isometric drawings
   f. Identify assembly drawings
4. List the Purpose of Each Type of Drawing
   a. Identify the purpose of orthographic (3 views) drawings
   b. Identify the purpose of isometric drawing

c. Identify the purpose of exploded isometric drawing
d. Identify the purpose of assembly drawings

5. Verify Drawing Elements
   a. Determine the scale of the view or section
   b. Check for revisions
   c. Recognize out-of-date blueprints
6. Practice Geometric Dimensioning and Tolerancing (GD&T) Methodology
   a. Identify the purpose of GD&T
   b. Identify symbols for controlling location (or true position) of part features
   c. Identify symbols for controlling form (or alignment) of part features
   d. Identify symbols for showing datums and basic dimensions on drawings
   e. Identify symbols for Maximum Material Size (MMS) and Regardless of Feature Size (RFS)
7. Describe the Relationship of Engineering Drawings to Planning
   a. Discuss production schedule
   b. Discuss Material Resource Planning (MRP)
   c. Discuss inventory control records
8. Use Standards to Verify Requirements
   a. Discuss the purpose of standards
   b. Discuss source locations for standards

D. PERFORM MEASUREMENT/INSPECTION

1. Select Proper Measurement Tools
   a. Match appropriate measurement tools with various types of measurement requirements
   b. Demonstrate proper measurement tool usage
2. Perform Measurements With Hand Held Instruments
   a. Measure with steel rules (metric and inch)
   b. Measure with micrometers
   c. Measure with direct measuring instruments (i.e., vernier, dial, and digital instruments)

E. PERFORM ADVANCED MACHINING PROCESSES

1. Prepare and Plan For CNC Machining Operations
   a. Read and interpret blueprints
   b. Plan CNC machining operations
   c. Calculate speeds, feeds, and depth of cut for various CNC machine applications
   d. Determine proper cutting fluids/coolants for CNC machining
   e. Use the Machinery's Handbook as a reference for CNC machine applications
2. Select and Use CNC Tooling Systems
   a. Understand machinability and chip formation
   b. Select proper carbide insert material and geometry needed
   c. Assemble tooling components
   d. Select correct tooling systems
   e. Identify tooling cost factors
3. Program CNC Machines
   a. Identify CNC Applications

b. List various types of CNC machines
c. Discuss CNC machine control systems
d. Describe absolute and incremental coordinate systems
e. Plan and write program for CNC mills and lathes
f. Edit CNC programs

COURSE OBJECTIVES: SCANS COMPETENCIES

The Secretary's Commission on Achieving Necessary Skills (SCANS), U.S. Department of Labor, has identified in its "AMERICA 2000 REPORT" that all students should develop a new set of competencies and foundation skills if they are to enjoy a productive, full and satisfying life. These are in addition to the Technical Workplace Competencies required by industry. SCANS is made up of five competencies and a three-part foundation of skills and personal qualities that are needed for solid job performance.

The following activities will be performed by each student for successful completion of this course:

I. **COMPETENCIES**

A. Resources: Identifies, organizes, plans, and allocates resources
1. follows a schedule to complete assigned tasks on time
2. provide a self-evaluation of performance based on the time and quality of work

B. Interpersonal: Works with others
1. complete assigned responsibilities within the shop floor serving as a member of the team
2. provide individual assistance/direction to peers as requested
3. produce machine parts to acceptable levels of quality as required
4. works well with all members of the class

C. Information: Acquires and uses information
1. read and interpret blueprints
2. organize and apply theories of machine tool operation

D. Systems: Understands complex inter-relationships
1. demonstrate knowledge of the following systems:
   a. laboratory organization structure: physical and social
   b. organization of personnel and facilities on the shop floor
   c. systematic approach to the metal removal process
   d. dimensioning and measurement systems
   e. systematic organization of training materials
2. monitors and corrects performance during
   a. the machining process
   b. adjustments of individual laboratory work schedule
   c. constantly evaluating the quality of work to achieve acceptable standards
   d. maintains record of evaluations and sets individual goals

E. ***Technology:*** *Works with a variety of technologies*

1. chooses procedure, tools and equipment required to produce a part using CNC
2. applies appropriate procedures and uses appropriate tools and equipment to produce a machined part to acceptable standards
3. maintains and troubleshoots equipment
   a. applies appropriate preventative maintenance
   b. when operating machines
   c. reports all malfunctions of equipment to supervisor/instructor
   d. perform clean-up assignments of machine and shop floor at the end of the laboratory

II. FOUNDATION SKILLS

A. ***Basic Skills:*** *Reads, writes, performs arithmetic and mathematical operations, listens and speaks.*

1. ***Reading:*** *Locates, understands, and interprets written information in prose and in documents such as manuals, graphs, and schedules*
   a. studies student laboratory manual
   b. interprets blueprints and technical drawings
   c. read/studies textbook
   d. follow a daily laboratory schedule to maintain appropriate time-line and product completion

2. ***Writing:*** *Communicates thoughts, ideas, information, and messages in writing; and creates documents such as letters, directions, manuals, reports, graphs, and flow charts*
   a. outline the steps necessary to produce a simple machine part
   b. maintain a lecture notebook
   c. submit written responses to chapter question assignments
   d. complete all written assignments

3. ***Arithmetic/Mathematics:*** *Perform basic computations and approaches practical problems by choosing appropriately from a variety of mathematical techniques*
   a. determines optimum machining speeds, feeds, and depth of cut
   b. calculates "value added to the part"
   c. aligns machine and/or work holding device
   d. taps and threads
   e. keeps a running computation of individual grade
   f. use trigonometry to solve angle and taper calculations

4. ***Listening:*** *Receives, attends to, interprets, and responds to verbal messages and other cues*
   a. assimilate classroom instruction
   b. interpret and assimilate video instruction
   c. observe laboratory demonstrations
   d. seek and receive individualized instruction in the laboratory

5. ***Speaking:*** *Organizes ideas and communicates orally*
   a. participates in classroom discussions
   b. organize ideas and communicate specific questions to the instructor

c. verbally affirms understanding of a concept, procedure, or required skill

d. communicates with peers to ensure the smooth and safe operation of the laboratory

B. ***Thinking Skills:*** *Thinks creatively, makes decisions, solves problems, visualizes, knows how to learn and reasons.*

1. ***Decision Making:*** *Specifies goals and constraints, generates alternatives, considers risks, and evaluates and chooses best alternative*
   a. identifies personal goals
   b. identifies actions required to accomplish personal goals
2. ***Problem Solving:*** *Recognizes problems and devises and implements plan of action*
   a. makes daily accommodations to stay on schedule
   b. seeks additional instruction/clarification for assignment completion
   c. balances social and academic life/responsibilities
   d. accepts responsibility
3. ***Seeing Things In the Mind's Eye:*** *Organizes, and processes symbols, pictures, graphs, objects, and other information*
   a. interprets technical drawings
   b. interprets technical illustrations and symbols
   c. understands both written and verbal instructions
   d. assimilates process during instructor demonstrations
4. ***Knowing How to Learn:*** *Use efficient learning techniques to acquire and apply new knowledge and skills*
   a. demonstrate mastery of the basic skills and techniques
   b. use these sequential skills to support mastery of new skills
   c. understand the sequential nature of acquired skills and the subsequent knowledge application of new skills and techniques
5. ***Reasoning:*** *Discovers a rule or principle underlying the relationship between two or more objects and applies it when solving a problem*
   a. understands that practice may not make it perfect but it certainly will improve the skill of the operator
   b. understands that the quality of the product is a function of the time of the operation and the attitude and skill of the machinist
   c. understands the relationship between different metals and the tool applied to the metal surface and adjusts machining parameters accordingly

C. ***Personal Qualities:*** *Displays responsibility, self-esteem, sociability, self-management, and integrity and honesty.*

1. ***Responsibility:*** *Exerts a high level of effort and perseveres towards goal attainment*
   a. develops an understanding that in order to be successful you must be a "good" student
   b. develops an understanding that a "good" student is the one who is prompt to every class and has prepared for the day's work
   c. develops an understanding good students know what they are going to do in class and does not waste time

d. develops a fine work-ethic

2. ***Self-Esteem:*** *Believes in own self-worth and maintains a positive view of self*
   a. learns to take pride in his or her work through positive reinforcement
   b. sees himself or herself as an asset to the class through continued contributions to the group and a shared common goal
   c. understands that an individual with a positive attitude and the belief in their own abilities will systematically seek solutions and be a valuable employee

3. ***Sociability:*** *Demonstrates understanding, friendliness, adaptability, empathy, and politeness in group settings*
   a. assist classmates in improving technical skills
   b. assist students with special needs as a peer mentor
   c. share laboratory resources (machines, tools and instructor's individual attention)

4. ***Self-Management:*** *Assesses self accurately, sets personal goals, monitors progress, and exhibits self-control*
   a. perform in-process quality checks on machined parts
   b. maintain a record of academic achievement (individual grade book)
   c. make accommodations to laboratory schedules due to broken machines/tools
   d. accept the responsibility for self-management

5. ***Integrity/Honesty:*** *Chooses ethical courses of action*
   a. accept the responsibility for own actions
   b. exhibit personal honesty at all times
   c. accept the challenge of doing your own work in the laboratory, during examination, and on outside assignments
   d. understand the consequences of unethical behaviors

Appropriate Reference Materials:

1. Machinery's Handbook, Industrial Press
2. Technology of Machine Tools, 4th Ed., McGraw Hill Publishers

MET205
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*M*achine Tool *A*dvanced *S*kills
*T*echnology Program

MAST

COURSE SYLLABUS

STATICS

150

MAST PROGRAM
COURSE SYLLABUS
STATICS

Lecture hours/week: 3 **Lab hours/week: 3** **Credit hours: 4**

COURSE DESCRIPTION:

This is a basic course in applied Statics and Mechanics and will prepare the student for courses in Strength of Materials and Machine Design. The student will acquire a fundamental understanding of concepts and principles which apply in the calculations of such things as: levers, structural members, inclined planes, sheaves, machined parts and structural joints. Other topics will include: coplanar forces, equilibrium of forces, structural analysis, free-body diagrams, laws of friction and the calculation of centroids and centers of gravity.

PREREQUISITES: Plane Trigonometry

REQUIRED COURSE MATERIALS:

Textbook: Applied Statics and Strength of Materials, Spiegel and Limbunner, Merrill Publishers

Lab Manual: **NONE**

Required Materials:

Engineering paper, green
Scientific Calculator

METHODS OF INSTRUCTION:

Lecture: Didactic presentations will include lecture, video and demonstrations.

Laboratory: Laboratory assignments will require student to solve appropriate static problems.

Method of Evaluation: A student's grade will be based on multiple measures of performance. The assessment will measure development of independent critical thinking skills and will include evaluation of the student's ability to:

1. perform the manipulative skills of the craft as required to satisfactorily complete laboratory assignments
2. apply theory to laboratory assignments
3. satisfactorily perform on written, oral, and practical examinations
4. satisfactorily perform on outside assignments including writing assignments
5. contribute to class discussions
6. maintain attendance per current policy

LECTURE OUTLINE:

	Lecture Topics	Text Reference Page	Contact Hrs.
Unit 1	**Introduction to Mechanics**	**1-16**	
1.01	Definition of Mechanics	1	
1.02	Problem in Applied Mechanics	1-2	
1.03	Procedures in the Solution on Mechanics Problems	3-5	
1.04	Standards of Workmanship in Problem Solutions	9-12	
Unit 2	**Basic Principles of Statics**	**17-71**	
2.01	Force	17	
2.02	Types of Force	17	
2.03	Characteristics and Units of a Force	17	
2.04	Vector and Scalar Quantities	19	
2.05	Transmissibility of Force	18	
2.06	Types of Force Systems	21	
2.07	Components of a Force	22	
2.08	Resultant of Two Concurrent Forces	36	
2.09	Moments of a Force	47	
2.10	The Principles of Moments Viraginous Theorem	51	
2.11	Couples	59	
2.12	Resultant of Parallel Forces	53	
2.13	Resolution of a Force into Parallel	53	
2.14	Equilibrium of Force Systems Components	75	
2.15	Principles of Force Equilibrium	75	
2.16	Supports and Support Reactions		
2.17	Free-body Diagrams	76	
2.18	Problems in Equilibrium of Coplanar Force Systems		
Unit 3	**Coplanar, Parallel Force Systems**	**36-91**	
3.01	Resultant of Coplanar, Parallel Forces	36-71	
3.02	Resultants of Distributed Loads	36-71	
3.03	Equilibrium of Coplanar, Parallel Force Systems	75-91	
Unit 4	**Coplanar, Concurrent Force Systems**	**53-112**	
4.01	Resultants of Coplanar, Concurrent Force Systems	36-71	
4.02	Equilibrium of Coplanar, Concurrent Force Systems	5-91	
4.03	Trusses	109	
4.04	Stresses in Members of Trusses	111	
4.05	Ropes over Sheaves and Pulleys		
4.06	Stresses in Trusses; Analytical		

	Method of Joints	112-118
4.07	Stresses in Trusses; the Graphical Method of Joints	112-118
4.08	Stresses in Trusses; the Graphical Method of Combined Diagrams	112-118
4.09	Three-force Members	
4.10	Graphical Determination of Reactions Using Three-force Principle	
Unit 5	**Coplanar, Nonconcurrent Force Systems**	**62-119**
5.01	Resultant of Coplanar, Nonconcurrent Force Systems	62
5.02	Equilibrium of Coplanar, Nonconcurrent force Systems	93
5.03	Determination of Reactions; Graphical String-polygon Method	
5.04	Determination of Reactions; Analytical Method	112-118
5.05	Pin Reactions; the Method of Members	
5.06	Stresses in Trusses; the Method of Sections	119
5.07	Counter Diagonals in Trusses	
Unit 6	**Noncoplanar, Parallel Force Systems**	**75-105**
6.01	Resultant of a Noncoplanar, Parallel Force Systems	
6.02	Equilibrium of Noncoplanar, Parallel Force System	
Unit 7	**Noncoplanar, Concurrent Force Systems**	**75-105**
7.01	Components of a Force in Space	
7.02	Equilibrium of Noncoplanar, Concurrent Force Systems	
Unit 8	**Noncoplanar, Nonconcurrent Force Systems**	**75-105**
8.01	Equilibrium of Noncoplanar, Nonconcurrent Force Systems	93
Unit 9	**Friction**	**143-165**
9.01	Coefficient of Friction, Angle of Friction, and Angle of Repose	143-146
9.02	Laws of Friction	144
9.03	Friction Problems	147
9.04	Belt Friction	165
9.05	Rolling Resistance	
	Total Lecture Hours	**36**

LAB OUTLINE:

Lab Topics	Contact Hrs.
Introduction to Mechanics	2
Basic Principles of Statics	6
Coplanar, Parallel Force Systems	3
Coplanar, Concurrent Force Systems	6
Coplanar, Nonconcurrent Force Systems	4
Noncoplanar, Parallel Force Systems	3
Noncoplanar, Concurrent Force Systems	3
Noncoplanar, Nonconcurrent Force Systems	3
Friction	6
Total Lab Hours	**36**

COURSE OBJECTIVES: TECHNICAL COMPETENCIES

After the successful completion of this course the student will be able to:

A. APPLY MATHEMATICAL CONCEPTS

1. Perform Basic Arithmetic Functions
   a. Add, subtract, multiply and divide whole numbers
   b. Add, subtract, multiply, and divide fractions
   c. Add, subtract, multiply, and divide decimals
2. Interconvert Fractions/Decimals
   a. Convert fractions to decimal equivalents
   b. Convert decimal values to nearest fractional equivalent
   c. Use Decimal Equivalent Chart for conversions
3. Interconvert Metric/English measurements
   a. Convert English dimensions to Metric
   b. Convert Metric dimensions to English
   c. Use Metric/English conversion chart
4. Perform Basic Trigonometric Functions
   a. Solve for unknown angles
   b. Solve for unknown sides
5. Solve Static Systems for Resultant Forces
   a. Solve for the following coplanar force systems: parallel, concurrent and nonconcurrent
   b. Solve for the following Noncoplanar force systems: parallel, concurrent and nonconcurrent
6. Solve Engineering Equations
   a. Solve linear algebraic equations for an unknown
   b. Solve a system of linear equations with 2 unknowns
   c. Solve right triangles for unknown sides or angles
   d. Use the law of sines and cosines to solve obtuse triangles with unknown sides and angles
   e. Calculate factors of Friction
7. Use all Functions of a Scientific Calculator
   a. Apply all trigonometric functions
   b. Apply all algebraic functions

c. Apply all statistical functions

COURSE OBJECTIVES: SCANS COMPETENCIES

The Secretary's Commission on Achieving Necessary Skills (SCANS), U.S. Department of Labor, has identified in its "AMERICA 2000 REPORT" that all students should develop a new set of competencies and foundation skills if they are to enjoy a productive, full and satisfying life. These are in addition to the Technical Workplace Competencies required by industry. SCANS is made up of five competencies and a three-part foundation of skills and personal qualities that are needed for solid job performance.

The following activities will be performed by each student for successful completion of this course:

I. **COMPETENCIES**

A. ***Resources:*** *Identifies, organizes, plans, and allocates resources*
   1. follows a schedule to complete assigned tasks on time
   2. provide a self-evaluation of performance based on the time and quality of work

B. ***Interpersonal:*** *Works with others*
   1. complete assigned responsibilities within the class serving as a member of the team
   2. provide individual assistance/direction to peers as requested

C. ***Information:*** *Acquires and uses information*
   1. read and interpret blueprints
   2. organize and apply theories of mechanics, forces and friction

D. ***Systems:*** *Understands complex inter-relationships*
   1. demonstrate knowledge of the following systems:
      a. laboratory organization structure: physical and social
      b. systematic organization of training materials
   2. monitors and corrects performance during
      a. adjustments of individual laboratory work schedule
      b. constantly evaluating the quality of work to achieve acceptable standards
      c. maintains record of evaluations and sets individual goals

E. ***Technology:*** *Works with a variety of technologies*
   1. chooses procedure and formulas necessary for problem solving.

II. **FOUNDATION SKILLS**

A. ***Basic Skills:*** *Reads, writes, performs arithmetic and mathematical operations, listens and speaks.*
   1. ***Reading:*** *Locates, understands, and interprets written information in prose and in documents such as manuals, graphs, and schedules*
      a. studies student laboratory manual
      b. interprets diagrams and technical drawings
      c. read/studies textbook

2. ***Writing:*** *Communicates thoughts, ideas, information, and messages in writing; and creates documents such as letters, directions, manuals, reports, graphs, and flow charts*
   a. outline the steps necessary for problem solving
   b. maintain a lecture notebook
   c. submit written responses to chapter question assignments
   d. complete all written assignments
3. ***Arithmetic/Mathematics:*** *Perform basic computations and approaches practical problems by choosing appropriately from a variety of mathematical techniques*
   a. add, subtract, multiply and divide whole numbers
   b. add, subtract, multiply, and divide fractions
   c. add, subtract, multiply, and divide decimals
   d. convert fractions to decimal equivalents
   e. convert decimal values to nearest fractional equivalent
   f. use Decimal Equivalent Chart for conversions
   g. convert English dimensions to Metric
   h. convert Metric dimensions to English
   i. use Metric/English conversion chart
   j. solve for unknown angles
   k. solve for unknown sides
   l. solve for the following coplanar force systems: parallel, concurrent and nonconcurrent
   m. solve for the following noncoplanar force systems: parallel, concurrent and nonconcurrent
   n. solve linear algebraic equations for an unknown
   o. solve a system of linear equations with 2 unknowns
   p. solve right triangles for unknown sides or angles
   q. use the law of sines and cosines to solve obtuse triangles with unknown sides and angles
   r. calculate factors of friction
   s. apply all trigonometric calculator functions
   t. apply all algebraic calculator functions
   u. apply all statistical calculator functions
   v. calculates coplanar, parallel force systems
4. ***Listening:*** *Receives, attends to, interprets, and responds to verbal messages and other cues*
   a. assimilate classroom instruction
   b. observe laboratory demonstrations
   c. seek and receive individualized instruction in the laboratory
5. ***Speaking:*** *Organizes ideas and communicates orally*
   a. participates in classroom discussions
   b. organize ideas and communicate specific questions to the instructor
   c. verbally affirms understanding of a concept, procedure, or required skill

B. ***Thinking Skills:*** *Thinks creatively, makes decisions, solves problems, visualizes, knows how to learn and reasons.*

1. ***Decision Making:*** *Specifies goals and constraints, generates alternatives, considers risks, and evaluates and chooses best alternative*
   a. identifies personal goals
   b. identifies actions required to accomplish personal goals
2. ***Problem Solving:*** *Recognizes problems and devises and implements plan of action*
   a. makes daily accommodations to stay on schedule
   b. seeks additional instruction/clarification for assignment completion
   c. balances social and academic life/responsibilities
   d. accepts responsibility
3. ***Seeing Things In the Mind's Eye:*** *Organizes, and processes symbols, pictures, graphs, objects, and other information*
   a. interprets technical drawings
   b. interprets technical illustrations and symbols
   c. understands both written and verbal instructions
   d. assimilates process during instructor demonstrations
4. ***Knowing How to Learn:*** *Use efficient learning techniques to acquire and apply new knowledge and skills*
   a. demonstrate mastery of the basic skills and techniques
   b. use these sequential skills to support mastery of new skills
   c. understand the sequential nature of acquired skills and the subsequent knowledge application of new skills and techniques
5. ***Reasoning:*** *Discovers a rule or principle underlying the relationship between two or more objects and applies it when solving a problem*
   a. understands that practice may not make it perfect but it certainly will improve the skill of the technician

C. ***Personal Qualities:*** *Displays responsibility, self-esteem, sociability, self-management, and integrity and honesty.*
1. ***Responsibility:*** *Exerts a high level of effort and perseveres towards goal attainment*
   a. develops an understanding that in order to be successful you must be a "good" student
   b. develops an understanding that a "good" student is the one who is prompt to every class and has prepared for the day's work
   c. develops an understanding good students know what they are going to do in class and does not waste time
   d. develops a fine work-ethic
2. ***Self-Esteem:*** *Believes in own self-worth and maintains a positive view of self*
   a. learns to take pride in his or her work through positive reinforcement
   b. sees himself or herself as an asset to the class through continued contributions to the group and a shared common goal
   c. understands that an individual with a positive attitude and the belief in their own abilities will systematically seek solutions and be a valuable employee
3. ***Sociability:*** *Demonstrates understanding, friendliness, adaptability, empathy, and politeness in group settings*

a. assist classmates in improving technical skills
b. assist students with special needs as a peer mentor

4. ***Self-Management:*** *Assesses self accurately, sets personal goals, monitors progress, and exhibits self-control*
   a. perform in-process checks on calculations
   b. maintain a record of academic achievement (individual gradebook)
   c. accept the responsibility for self-management
5. ***Integrity/Honesty:*** *Chooses ethical courses of action*
   a. accept the responsibility for own actions
   b. exhibit personal honesty at all times
   c. accept the challenge of doing your own work in the laboratory, during examination, and on outside assignments
   d. understand the consequences of unethical behaviors

Appropriate Reference Materials:

1. Machinery's Handbook, Industrial Press
2. Applied Statics and Strength of Material, Spiegel and Limbunner

MET206
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*M*achine Tool *A*dvanced *S*kills
*T*echnology Program

MAST

COURSE SYLLABUS

MANUFACTURING PROCESSES

MAST PROGRAM
COURSE SYLLABUS
MANUFACTURING PROCESSES

Lecture hours/week: 3 **Lab hours/week: 3** **Credit hours: 4**

COURSE DESCRIPTION:

Essential studies into the processes and materials for manufacturing, including metal casting, hot and cold forming of steel, powder metallurgy and plastics. Analysis of newer processes such as electrical discharge machining, chemical machining, and ultra-sonic machining; with a emphasis on the economical manufacturing of products.

PREREQUISITES: **NONE**

REQUIRED COURSE MATERIALS:

Textbook: Modern Materials and Manufacturing Processes, John E. Neeley & Richard R. Kibbe, Prentice Hall Career & Technology, Englewood Cliffs, N.J., 1987

Lab Manual: None Required

Student Tool List: Safety glasses

METHODS OF INSTRUCTION:

Lecture: Didactic presentations will include lecture, video and demonstrations.

Laboratory: Laboratory will consist of "hands-on" activities. Students will operate various conventional metalworking machines to manufacture a product.

Method of Evaluation: A student's grade will be based on multiple measures of performance. The assessment will measure development of independent critical thinking skills and will include evaluation of the student's ability to:

1. perform the manipulative skills of the craft as required to satisfactorily complete laboratory assignments
2. apply theory to laboratory assignments
3. perform on written, oral, or practical examinations
4. perform on outside assignments including writing assignments
5. contribute to class discussions
6. maintain attendance per current policy
7. follow all shop rules and safety regulations as stated in the laboratory manual

LECTURE OUTLINE:

Lecture Topics	Text Reference Page	Contact Hrs.
Introduction to the Course		1
The Manufacturing Industry	21	3
Material Resource Planning (MRP)	25	2
Processing of Metals: Casting	7	3
Processing of Metals: Hot Working	8	3
Processing of Metals: Cold Working	9	3
QUIZ I		1
Powder Metallurgy	10	2
Non-traditional Machining Processes	13	3
Plastics & Composite Processes	15	4
QUIZ II		1
Joining Processes	14	3
Corrosion & Protection for Materials	16	1
Design, Tooling & Production Lines	18	5
QUIZ III		—
	Total Lecture Hours	**36**

LAB OUTLINE:

Lab Topics	Contact Hrs.
Lab Orientation and Safety	2
Lab Sheet #1 - Stock preparation; measure (semi-precision), shear and debur	3
Lab Sheet #2 - Layout, drill, ream and debur holes	3
Lab Sheet #3 - Metal forming (bending) and countersinking holes	3
Lab Sheet #4 - Metal joining (welding), stress relieving and sawing	3
Mid-term project evaluation and rework	2
Lab Sheet #5 - Surface preparation (sand blast) and surface finish (paint)	3
CNC stock preparation	2
CNC Machining Demonstration and CIM Lab Demonstration	3
Lab Sheet #6 - Component sub-assembly and precision machining activity	3
Lab Sheet #7 - Sub-assembly manufacture (handle)	3
Lab Sheet #8 - Final assembly and test (final project evaluation)	3
Lab clean-up	3
Total Lab Hours	**36**

COURSE OBJECTIVES: TECHNICAL COMPETENCIES

After the successful completion of this course the student will be able to:

A. PRACTICE SAFETY

1. Follow Safe Operating Procedures for Hand and Machine Tools
   a. Identify and understand safe machine operating procedures
   b. Demonstrate safe machine operation

B. INTERPRET ENGINEERING DRAWINGS AND CONTROL DOCUMENTS

1. Describe the Relationship of Engineering Drawings to Planning

a. Discuss production schedule
b. Discuss Material Resource Planning (MRP)
c. Discuss inventory control records
d. Discuss shop floor routing documents

2. Use Standards to Verify Requirements
   a. Discuss the purpose of standards
   b. Discuss source locations for standards
3. Analyze Bill of Materials (BOM)
   a. Discuss components found on BOM
   b. Determine materials needed to produce the part
   c. Determine quantities necessary to produce the part
   d. Submit completed stock request form as required
   e. Submit completed tool request form as needed

C. RECOGNIZE DIFFERENT MANUFACTURING MATERIALS AND PROCESSES

1. Identify Materials With Desired Properties
   a. Discuss classification system for metals
   b. Describe general characteristics for carbon steels, tool steels, stainless steels, structural steels, cast irons, aluminum, and other commonly used metals

COURSE OBJECTIVES: SCANS COMPETENCIES

The Secretary's Commission on Achieving Necessary Skills (SCANS), U.S. Department of Labor, has identified in its "AMERICA 2000 REPORT" that all students should develop a new set of competencies and foundation skills if they are to enjoy a productive, full and satisfying life. These are in addition to the Technical Workplace Competencies required by industry. SCANS is made up of five competencies and a three-part foundation of skills and personal qualities that are needed for solid job performance.

The following activities will be performed by each student for successful completion of this course:

I. COMPETENCIES

A. Resources: Identifies, organizes, plans, and allocates resources
1. follows a schedule to complete assigned tasks on time
2. follows a schedule to maximize laboratory resources
3. determine the initial cost of materials and "value added" as result of processing

B. Interpersonal: Works with others
1. complete assigned responsibilities within the manufacturing lab serving as a member of the team
2. provide individual assistance/direction to peers as requested

C. Information: Acquires and uses information
1. read and interpret blueprints
2. organize and apply theories of manufacturing processes

3. perform basic semi-precision and precision layout as necessary

D. ***Systems:*** *Understands complex inter-relationships*

1. demonstrate knowledge of the following systems:
   a. organization of personnel and facilities in the manufacturing lab
   b. systematic approach to the production process
   c. dimensioning and measurement systems
2. monitors and corrects performance during
   a. the manufacturing process
   b. adjustments of individual laboratory work schedule
   c. constantly evaluating the quality of work to achieve acceptable standards

E. ***Technology:*** *Works with a variety of technologies*

1. chooses procedure, tools and equipment required to fabricate a product
2. applies appropriate procedures and uses appropriate tools and equipment to fabricate a part to referenced engineering standards

II. FOUNDATION SKILLS

A. ***Basic Skills:*** *Reads, writes, performs arithmetic and mathematical operations, listens and speaks.*

1. ***Reading:*** *Locates, understands, and interprets written information in prose and in documents such as manuals, graphs, and schedules*
   a. read/studies textbook
   b. studies student laboratory exercises
   c. interprets blueprints and technical drawings
   d. follow a daily laboratory schedule to maintain appropriate time-line and product completion

2. ***Writing:*** *Communicates thoughts, ideas, information, and messages in writing; and creates documents such as letters, directions, manuals, reports, graphs, and flow charts*
   a. outline the steps necessary to produce simple product
   b. maintain a lecture notebook
   c. submit written responses to chapter question assignments

3. ***Arithmetic/Mathematics:*** *Perform basic computations and approaches practical problems by choosing appropriately from a variety of mathematical techniques*
   a. calculate bend allowances for sheet metal and metal plate
   b. keeps a running computation of individual grade

4. ***Listening:*** *Receives, attends to, interprets, and responds to verbal messages and other cues*
   a. assimilate classroom instruction
   b. interpret and assimilate video instruction
   c. observe and assimilate laboratory demonstrations
   d. seek and receive individualized instruction in the laboratory
   e. practices active listening by affirming understanding of verbal instructions, asking questions for clarification and probing for specifics

5. ***Speaking:*** *Organizes ideas and communicates orally*
   a. participates in classroom discussions

b. organize ideas and communicate specific questions to the instructor
c. verbally affirms understanding of a concept, procedure, or required skill
d. communicate with peers, instructors and supervisors to ensure the smooth and safe operation of the laboratory

B. ***Thinking Skills:*** *Thinks creatively, makes decisions, solves problems, visualizes, knows how to learn and reasons.*

1. ***Decision Making:*** *Specifies goals and constraints, generates alternatives, considers risks, and evaluates and chooses best alternative*
   a. applies knowledge of process and materials to select appropriate material and process for safe and economical service in a given application
   b. prioritizes activities for effective use of time
2. ***Problem Solving:*** *Recognizes problems and devises and implements plan of action*
   a. makes daily accommodations to stay on schedule
   b. seeks additional instruction/clarification for assignment completion
   c. troubleshoots manufacturing processes and equipment
   d. recognize problems in manufacturing and selects appropriate corrective or preventive action
3. ***Seeing Things In the Mind's Eye:*** *Organizes, and processes symbols, pictures, graphs, objects, and other information*
   a. visualize objects in three dimensions from engineering drawings
   b. visualize process during instructor lecture
   c. visualize the capabilities of various manufacturing processes and machine tools to generate desired features in raw stock in order to manufacture a simple product
4. ***Knowing How to Learn:*** *Use efficient learning techniques to acquire and apply new knowledge and skills*
   a. understand that practice will improve skill
   b. asks questions or seeks help when uncertain about new skills or knowledge
5. ***Reasoning:*** *Discovers a rule or principle underlying the relationship between two or more objects and applies it when solving a problem*
   a. apply general understanding of process and material characteristics to determine the process by which a part or piece of stock has been made
   b. applies knowledge of manufacturing materials and processes to develop a logical, sequential process plan
   c. apply broad understanding of processes, materials, product requirements, and manufacturing economics to consider and apply new or alternative techniques to reduce costs, save time and improve quality

C. ***Personal Qualities:*** *Displays responsibility, self-esteem, sociability, self-management, and integrity and honesty.*

1. ***Responsibility:*** *Exerts a high level of effort and perseveres towards goal attainment*
   a. displays promptness and preparation for the day's work

b. plans work to use time efficiently
c. accepts responsibility for mistakes, and takes corrective and preventive actions
d. takes initiative when needed to gain resources or assistance to complete assignments

2. ***Self-Esteem:*** *Believes in own self-worth and maintains a positive view of self*
   a. takes pride in work through positive reinforcement
   b. sees self as a valued member of the group through continued contributions toward common goals
3. ***Sociability:*** *Demonstrates understanding, friendliness, adaptability, empathy, and politeness in group settings*
   a. assist classmates in improving technical skills
   b. share laboratory resources (machines, tools and instructor's individual attention)
4. ***Self-Management:*** *Assesses self accurately, sets personal goals, monitors progress, and exhibits self-control*
   a. perform in-process quality checks on manufactured component parts
   b. maintain a record of academic achievement (individual grade book)
   c. accept responsibility for mistakes and infractions, and take steps to resolve or eliminate them
5. ***Integrity/Honesty:*** *Chooses ethical courses of action*
   a. accept the responsibility for own actions
   b. exhibit personal honesty at all times
   c. accept the challenge of doing your own work in the laboratory, during examination, and on outside assignments
   d. understand the consequences of unethical behaviors

Appropriate Reference Materials:

1. Machinery's Handbook, Industrial Press
2. Technology of Machine Tools, 4th Ed. McGraw Hill Publishers

MET301
01/060796

*M*achine Tool *A*dvanced *S*kills
*T*echnology Program

MAST

COURSE SYLLABUS

INTRODUCTION TO COMPUTER DRAFTING

MAST PROGRAM
COURSE SYLLABUS
INTRODUCTION TO COMPUTER DRAFTING

Lecture hours/week: 1 **Lab hours/week: 4** **Credit hours: 2**

COURSE DESCRIPTION:

This course introduces the student to computer-aided drafting (CAD). This introduction involves equipment, software, and basic command logic. Graphic images are created using introductory level commands.

PREREQUISITES: **NONE**

REQUIRED COURSE MATERIALS:

Textbook: AutoCAD and Its Applications, Terence Shumaker/David A. Madsen

Materials:
2 - HHDS 3 ½" diskettes
1 Ream of plain bond paper (20lb)
Notebook Paper
Felt tip pen
1 Pkg Calcomp Plotter Pens - Assorted Colors

METHODS OF INSTRUCTION:

Lecture: Classroom presentations will include lecture, video and demonstrations. Computer assisted instruction will be used.

Laboratory: Laboratory will be a "hands-on" drawing process using computer hardware, software, plotters and printers.

Method of Evaluation: A student's grade will be based on multiple measures of performance. The assessment will measure development of independent critical thinking skills and will include evaluation of the student's ability to:

1. perform the manipulative skills of the craft as required to satisfactorily complete laboratory assignments
2. apply theory to laboratory assignments
3. satisfactorily perform on written, oral, and practical examinations
4. satisfactorily perform on outside assignments including writing assignments
5. contribute to class discussions
6. maintain attendance per current policy

7. follow all safety regulations as stated in the class policies

LECTURE OUTLINE:

Lecture Topics	Text Reference Page	Contact Hrs.
Introduction to Course	----	
Required Materials and Tests	Handout	
Class Policies and Safety Concerns	Handout	
System Orientation	Appendix B, 1	
Operating Parameters and Drawing Aids	Chapters 2, 3, 4, 5	
Cartesian Coordinates	Chapter 6	
Display Commands	Chapter 9	
Draw Commands	Chapters 6, 7, 8, 13	
Edit Commands	Chapters 11, 12	
Text Commands	Chapter 10	
Inquiry Commands	Chapter 14	
DOS/Utility Commands	Chapters 15, 35	
Plot Specifications	Chapter 27	
Layer Command	Chapter 17	
Blocks	Chapter 21	
Dimensioning	Chapter 18	
Manufacturing/CAD Project		
	Total Lecture Hours	**12**

LAB OUTLINE:

Lab Topics	Contact Hrs.
System Orientation	2
Operating Parameters	2
Cartesian Coordinates	4
Displaying Different Views	1
Drawing Entities	4
Editing Existing Entities	2
Text on the Drawings	2
Inquiry - Obtaining Database Information	1
DOS/Utility Commands	1
Plotting	1
Using Layers	2
Creating Blocks	4
Dimensioning Drawings	4
Project	18
Total Lab Hours	**48**

COURSE OBJECTIVES: TECHNICAL COMPETENCIES

After the successful completion of this course the student will be able to:

A. PRACTICE SAFETY

1. Follow Safety Requirements
   a. Assume responsibility for the personal safety of oneself and others
   b. Develop a personal attitude towards safety
   c. Comply with established safety practices
   d. Use special caution with magnetic media
2. Maintain a Clean and Safe Work Environment
   a. Observe computer lab hygiene
   b. Put equipment and supplies away when work is finished

B. APPLY MATHEMATICAL CONCEPTS

1. Use Inquiry Commands to Perform Basic Addition and Subtraction
2. Use Inquiry Commands to Find Area, Length and Distance
3. Apply Basic Concepts of Geometry Using CAD Software
4. Convert English Dimensions to Metric

C. APPLY DRAFTING CONCEPTS TO COMPUTER AIDED DRAFTING

1. Identify the Equipment Used in Computer Aided Drafting
2. Describe the Methods and Procedures Used to Produce Cad Drawings

D. ESTABLISH AND USE OPERATING PARAMETERS

1. Use Dos Commands to Manage Drawing Files
2. Describe and Use Menus and Screen Prompts
3. Set UNITS
4. Set LIMITS
5. Set GRID
6. Set SNAP
7. Establish a Prototype Drawing
8. Open, Close and Save Files
9. Use ORTHO to Create Lines at Right Angles

E. USE CARTESIAN COORDINATE POINT ENTRY SYSTEMS

1. Create Drawings Using Absolute Coordinates
2. Create Drawings Using Relative Coordinates
3. Create Drawings Using Polar Coordinates
4. Determine Which System Is Most Efficient for Each Application

F. USE DISPLAY COMMANDS TO VIEW DRAWINGS

1. Enlarge or Reduce the Amount of Drawing Displayed on the Monitor Using Zoom Options
2. Redraw the Screen to Clean up Clutter
3. Specify and Save Certain Views on a Drawing
4. Manipulate Your View of the Drawing Without Changing the Magnification

G. USE CAD COMMANDS TO CREATE DRAWINGS

1. Determine Most Efficient Sequence of Commands to Produce Required Object
2. Use Standard Line Types to Indicate Drawing Features
3. Use POLYLINES to Show Width And/or Taper

4. Draw Circles Using the CIRCLE Command Options
5. Draw Arcs Using the ARC Command Options
6. Use Ellipses, Polygons and Doughnuts to Represent Drawing Features
7. Use OSNAPS to Create Accurate Geometry
8. Use ARRAY to Create Rectangular and Circular Repetitions

H. USE CAD COMMANDS TO EDIT DRAWINGS

1. Create Angled Corners Using the CHAMFER Command
2. Create Rounded Corners Using the FILLET Command
3. Remove Portions of Entities Using the BREAK Command
4. Change the Location of an Entity
5. Use TRIM and EXTEND to Shorten or Lengthen an Object
6. Use COPY to Create Duplicates of Existing Objects
7. Change Angular Position of Objects
8. Use the STRETCH and SCALE Commands to Change to Size Length and Height of an Object

I. PLACE TEXT ON A DRAWING

1. Use the Text Command to Add Notes and Callouts to a Drawing
2. Set Text Style
3. Draw Special Symbols Using Control Characters
4. Underscore and Overscore Text
5. Edit Existing Text

J. OBTAIN INFORMATION ABOUT A DRAWING

1. Determine the Area of an Object by Adding and Subtracting Entities
2. List Database Information Related to Entities and Drawings
3. Track Time Spent in a Drawing Session

K. USE DOS/UTILITY COMMANDS TO MANAGE FILES

1. Explain the Meaning and Use of DOS File Extensions
2. List Files Using FILE UTILITIES
3. Copy, Rename and Delete Files Using FILE UTILITIES
4. Format, Label and List Contents of Disks Using DOS Commands
5. Copy, Rename, and Delete Files Using DOS Commands

L. PRODUCE PLOTTED COPIES OF DRAWINGS

1. Set up Plotter
   a. Load media
   b. Load pens
2. Set up Parameters Within a Drawing File for Plotting

M. USE LAYERS TO SEPARATE DETAILS OF A DESIGN

1. Name and Create Layers
   a. Select colors
   b. Set linetypes
2. Set Layers
3. Control Visibility of Layers
4. Lock Layers
5. Freeze Layers
6. Rename Layer

7. Edit Layer Properties

N. CREATE AND STORE SYMBOLS

1. Create and Save Blocks
2. Insert Blocks into a Drawing
3. Edit Blocks and Update Existing Insertions

O. DESCRIBE SIZE, SHAPE AND LOCATION OF DRAWING FEATURES WITH DIMENSIONS

1. Dimension Objects According to ANSI Standards
2. Identify and Set Variables to Control the Appearance of Dimensions
3. Add Linear, Angular, Diameter and Radius Dimensions to a Drawing
4. Set Units and Decimal Places
5. Apply Tolerances as Required

P. USE CAD SKILLS TO CREATE A DRAWING PROJECT RELATED TO STUDENT'S MAJOR

COURSE OBJECTIVES: SCANS COMPETENCIES

The Secretary's Commission on Achieving Necessary Skills (SCANS), U.S. Department of Labor, has identified in its "AMERICA 2000 REPORT" that all students should develop a new set of competencies and foundation skills if they are to enjoy a productive, full and satisfying life. These are in addition to the Technical Workplace Competencies required by industry. SCANS is made up of five competencies and a three-part foundation of skills and personal qualities that are needed for solid job performance.

The following activities will be performed by each student for successful completion of this course:

I. COMPETENCIES

A. ***Resources:*** *Identifies, organizes, plans, and allocates resources*

1. follows a schedule to complete assigned tasks on time
2. determine the appropriate media and instruments to complete assignments
3. provide a self-evaluation of performance based on the time and quality of work

B. ***Interpersonal:*** *Works with others*

1. complete assigned responsibilities within the course serving as a member of the team
2. provide individual assistance/direction to peers as requested
3. produce drawings to acceptable levels of quality as required
4. works well with all members of the class

C. ***Information:*** *Acquires and uses information*

1. reads and interprets text and handouts
2. organizes and applies theories of drafting and design
3. applies lecture concepts to lab techniques

D. ***Systems:*** *Understands complex inter-relationships*

1. demonstrates knowledge of the following systems:
   a. laboratory organization structure: physical and social
   b. organization of personnel and facilities in the computer drafting lab
   c. systematic approach to the drafting and design process
   d. dimensioning and measurement systems
   e. systematic organization of training materials
2. monitors and corrects performance
   a. during the drawing process
   b. making adjustments to individual laboratory work schedules
   c. while constantly evaluating the quality of work to achieve acceptable standards
   d. though maintaining a record of evaluations
   e. to meet individual goals

E. ***Technology:*** *Works with a variety of technologies*

1. chooses, procedures media and supplies required to produce a drawing
2. applies appropriate procedures and uses appropriate tools and equipment to produce a drawing to acceptable standards
3. maintains and troubleshoots equipment and tools
   a. applies appropriate preventative maintenance
   b. reports all malfunctions of equipment to supervisor/instructor
   c. performs clean-up assignments of lab

II. FOUNDATION SKILLS

A. ***Basic Skills:*** *Reads, writes, performs arithmetic and mathematical operations, listens and speaks.*

1. ***Reading:*** *Locates, understands, and interprets written information in prose and in documents such as manuals, graphs, and schedules*
   a. interprets technical drawings
   b. reads/studies concepts in textbook
   c. follows a daily laboratory schedule to maintain appropriate time-line to meet scheduled deadlines
   d. interprets concepts in texts to develop accurate drawings

2. ***Writing:*** *Communicates thoughts, ideas, information, and messages in writing; and creates documents such as letters, directions, manuals, reports, graphs, and flow charts*
   a. outlines the steps necessary to produce a simple drawing
   b. sketches object to produce a final drawing
   c. maintains a schedule of assignments and deadlines (these may take the form of a chart, graph, etc.)
   d. maintains a lecture notebook
   e. submits written responses to chapter question assignments
   f. completes all written assignments

3. ***Arithmetic/Mathematics:*** *Perform basic computations and approaches practical problems by choosing appropriately from a variety of mathematical techniques*
   a. bisects lines, circles, arcs and angles
   b. divides objects into equal parts
   c. applies tolerances
   d. applies and verify dimensions
   e. uses fraction and decimal values
   f. applies principles of trigonometry and geometry to solve angle calculations and tangencies and to define points
4. ***Listening:*** *Receives, attends to, interprets, and responds to verbal messages and other cues*
   a. assimilates concepts presented by lecture, video or any multimedia methods
   b. observes laboratory demonstrations for technique and safety instructions
   c. seeks and receive individualized instruction in the laboratory
   d. actively listens and participates in discussions and question/answer sessions
5. ***Speaking:*** *Organizes ideas and communicates orally*
   a. participates in classroom discussions
   b. organizes ideas and communicates specific questions to the instructor
   c. verbally affirms understanding of a concept, procedure, or required skill
   d. communicates with peers to ensure the efficient and safe completion of assignments

B. ***Thinking Skills:*** *Thinks creatively, makes decisions, solves problems, visualizes, knows how to learn and reason.*
1. ***Decision Making:*** *Specifies goals and constraints, generates alternatives, considers risks, and evaluates and chooses best alternative*
   a. identifies personal goals
   b. prioritizes goals
   c. identifies specific actions required to accomplish personal goals
   d. allows for flexibility in meeting goals as circumstances change
2. ***Problem Solving:*** *Recognizes problems and devises and implements plan of action*
   a. makes daily accommodations to stay on schedule
   b. seeks additional instruction/clarification for assignment completion
   c. balances social and academic life/responsibilities
   d. accepts responsibility
3. ***Seeing Things In the Mind's Eye:*** *Organizes, and processes symbols, pictures, graphs, objects, and other information*
   a. understands both written and verbal instructions
   b. assimilates process during instructor demonstrations

c. interprets technical drawings
d. interprets technical illustrations and symbols
e. interprets and applies geometric construction concepts

4. ***Knowing How to Learn:*** *Use efficient learning techniques to acquire and apply new knowledge and skills*
   a. demonstrates mastery of the basic skills and techniques
   b. uses these sequential skills to support mastery of new skills
   c. consistently applies the sequential nature of acquired skills to the subsequent knowledge application of new skills and techniques

5. ***Reasoning:*** *Discovers a rule or principle underlying the relationship between two or more objects and applies it when solving a problem*
   a. understands that practice will improve the skill of the technician
   b. understands that the quality of the product is a function of time spent and the attitude and skill of the technician

C. ***Personal Qualities:*** *Displays responsibility, self-esteem, sociability, self-management, and integrity and honesty.*

1. ***Responsibility:*** *Exerts a high level of effort and perseveres towards goal attainment*
   a. attends class as scheduled and is well prepared for the day's work
   b. completes assignments independently and on time
   c. works well within a team while completing individual assignments

2. ***Self-Esteem:*** *Believes in own self-worth and maintains a positive view of self*
   a. learns to take pride in his or her work through positive reinforcement
   b. sees himself or herself as an asset to the class through continued contributions to the group and a shared common goal
   c. understands that an individual with a positive attitude and the belief in their own abilities will systematically seek solutions and be a valuable employee

3. ***Sociability:*** *Demonstrates understanding, friendliness, adaptability, empathy, and politeness in group settings*
   a. assists classmates in improving technical skills
   b. assists students with special needs as a peer mentor
   c. shares laboratory resources (computers, plotters and instructor's individual attention)

4. ***Self-Management:*** *Assesses self accurately, sets personal goals, monitors progress, and exhibits self-control*
   a. performs in-process quality checks on CAD drawings
   b. maintains a record of academic achievement (individual gradebook)
   c. maintains a schedule of deadlines, due dates, and other important dates (calendar)
   d. adjusts calendar to accommodate unexpected circumstances
   e. accepts the responsibility for self management

5. ***Integrity/Honesty:*** *Chooses ethical courses of action*

a. accepts responsibility for own actions
b. exhibits personal honesty at all times
c. accepts the challenge of doing his/her own work in the laboratory, during examination and on outside assignments
d. understands the consequences of unethical behaviors

***M*achine Tool *A*dvanced *S*kills**
***T*echnology Program**

MAST

COURSE SYLLABUS

CAD/CAM I

MAST PROGRAM
COURSE SYLLABUS
CAD/CAM I

Lecture hours/week: 3 **Lab hours/week: 3** **Credit hours: 4**

COURSE DESCRIPTION:

Student will introduced to "Process Modeling" utilizing a CNC graphics programming system called "SMARTCAM". Using engineering drawings, students will program various parts for both CNC mills and CNC lathes. Related topics include: job planning, tool selection, process model construction, tool path verification, machine simulation, quality control, CAD/CAM transfer and CNC code generation.

PREREQUISITES: NONE

REQUIRED COURSE MATERIALS:

Textbook: SMARTCAM-2D, Pelton, TSTC Pub., 2nd Ed.
Lab Manual: **NONE**

Materials and/or Supplies: 2 - double sided, high density 3 ½" floppy diskettes

METHODS OF INSTRUCTION:

Lecture: Didactic presentations will include lecture, overheads and SMARTCAM and related software demonstrations.

Laboratory: Laboratory will be a "hands-on" (computer based) process modeling using the SMARTCAM System.

Method of Evaluation: A student's grade will be based on multiple measures of performance. The assessment will measure development of independent critical thinking skills and will include evaluation of the student's ability to:

1. demonstrate the ability to use DOS commands
2. create a basic procedure for machining a part on a machine center and a turning center, including: machine tool selection, tool selection and application, operational sequences, speeds, feeds and depth of cuts and tool length offsets
3. develop job plans using SMARTCAM
4. demonstrate the ability to develop a SHAPE file in the SMARTCAM graphics system
5. demonstrate the ability to manipulate files to successfully complete a graphics project within a CAM system
6. create part profiles and part geometry to produce accurately coded information for both CNC lathes and mills
7. utilize plotters and printers to produce accurate documents

8. perform and demonstrate the ability to transfer CAD files to CAM files and CAM files to CAD files
9. generate a tool path from CAD to CAM files
10. edit a tool path from a CAD file and proof the tool path from a CAD file.
11. satisfactorily perform on written, oral, and practical examinations
12. satisfactorily perform on outside assignments including writing assignments
13. contribute to class discussions
14. maintain attendance per current policy

LECTURE OUTLINE:

	Lecture Topic	Text Reference Page	Contact Hrs.
Unit 1	**CNC/CAD/CAM Overview**		
1.01	Description of CNC	handouts	
1.02	Computer Systems Review	and	
1.03	Job Opportunities in the CAM Field	overheads	
1.04	Employability Skills in CAM		
Unit 2	**The Structure of a CAM System**		
2.01	From Print to Part	5-6	
2.02	The Graphical User Interface	11-18	
2.03	Working with SMARTCAM's Display Areas	37-41	
Unit 3	**Process Planning (Mill)**		
3.01	Interpreting a Part Print	handouts	
3.02	Creating a Job Sheet from a Part Print	overheads	
3.03	Entering Tool Information into the Job Plan	28-29	
	Review for Quiz 1		
	Quiz 1		
	Return and Discuss Quiz 1		
Unit 4	**Working with a CNC Process Model (Mill)**		
4.01	Starting a CNC Process Model	19-24; 37-42	
4.02	Roughing and Finishing an Existing Process Model	and	
4.03	Modifying Existing Geometry	handouts	
4.04	Methods for Creating Geometry for the Process Model		
Unit 5	**Generating CNC Code with a CAM System**		
5.01	Basic NC Code Structure	overheads	
5.02	Locating the Data Source for Code Generation		
5.03	How a CAM System Generates CNC Code		
	Review for Quiz 2		

	QUIZ 2	
Unit 6	**Additional Modeling Practices**	
6.01	Pocketing and Facing with Islands/Notches, etc.	21-22
6.02	Re-sequencing Machining Operations	
6.03	Rotate, Move, Copy, Mirror and Scale Commands	overheads
Unit 7	**Process Planning (Lathe)**	
7.01	CNC Lathe Coordinate Systems	overheads
7.02	Carbide Tooling for CNC Lathes	overheads
7.03	Entering Tool Information into the Job Plan	overheads
Unit 8	**Working with a CNC Process Model (Lathe)**	
8.01	Turning, Facing, Boring and Drilling	overheads
	Review for Quiz 3	
	Quiz 3	
Unit 9	**Additional Modeling Practices**	
9.01	Threading Cycles and Grooving Cycle	overheads
9.02	Roughing for Turning and Facing Operations	
Unit 10	**Working with CAD Geometry**	
10.01	Conventions of CAD Geometry	overheads
10.02	Using a CAM System to Transfer CAD Geometry	
10.03	Working with CAD Geometry in a CAM System	
10.04	Transferring a CNC Process Model to a CAD System	
	Quiz 4 Review	
	Quiz 4	
	Total Lecture Hours	**36**

LAB OUTLINE:

Lab Topics	Contact Hrs.
Job Plan	2
"Tryit" Exercises 1 thru 5	2
Simple Part Profile (Mill 1)	2
Simple Part Profile (Mill 2)	2
Profile with Roughing (Mill 3)	2
Using Multiple Tools (Mill 4)	2
Using Multiple Tools and Roughing (Mill 5)	2
Using Layers, Islands and Rough Facing (Mill 6)	3
Rough Processing (Mill 7)	2

Converting Geometry to Profiles, Using Copy (Mill 8)	2
Complex Part Geometry With Multiple Tools (Mill 9)	2
Using Rotate and Move Commands (Mill 10)	2
Roughing, Pocketing Drilling and Tapping (Mill 11)	2
Complex Modeling, Rotating, Moving Scaling (Mill 12)	3
Turning Lengths and Diameters (Lathe 1)	2
O.D. and I.D. Contour Turning (Lathe 2)	2
Multiple Tool with Roughing (Lathe 3)	2
Total Lab Hours	**36**

COURSE OBJECTIVES: TECHNICAL COMPETENCIES

After the successful completion of this course the student will be able to:

A. APPLY MATHEMATICAL CONCEPTS

1. Perform Basic Arithmetic Functions
   - a. Add, subtract, multiply and divide whole numbers
   - b. Add, subtract, multiply, and divide fractions
   - c. Add, subtract, multiply, and divide decimals
2. Interconvert Fractions/Decimals
   - a. Convert fractions to decimal equivalents
   - b. Convert decimal values to nearest fractional equivalent
   - c. Use Decimal Equivalent Chart for conversions
3. Interconvert Metric/English measurements
   - a. Convert English dimensions to Metric
   - b. Convert Metric dimensions to English
   - c. Use Metric/English conversion chart
4. Utilize Trigonometric Functions
   - a. Solve for unknown angles
   - b. Solve for unknown sides
5. Calculate Speeds and Feeds for Machining Using SMARTCAM's Job Plan Module
   - a. Calculate RPM for various metals and various tools
   - b. Calculate feed for various metals, tools, and depths of cut
6. Locate Machining Points from a Datum Point
   - a. Identify points using the Cartesian coordinate system
   - b. Identify points using the absolute dimensioning system
   - c. Identify points using the incremental dimensioning system

B. INTERPRET ENGINEERING DRAWINGS AND CONTROL DOCUMENTS

1. Review Blueprint Notes and Dimensions
   - a. Interpret basic blueprint terminology
   - b. Identify the types of dimensions
   - c. Identify general note symbols
   - d. Locate notes on a print
   - e. Interpret commonly used abbreviations and terminology
   - f. Determine tolerances associated with dimensions on a drawing
   - g. Determine the tolerance for a reference dimension
   - h. Determine the surface finish for a given part
   - i. List the essential components found in the general drawing notes

2. Identify Basic Layout of Drawings
   a. Interpret the meaning of lines used within a drawing
   b. Identify item number symbols
   c. Identify general note symbols
   d. List the essential components found in the title block
   e. Locate bill of materials in a drawing
   f. Identify the components found in the revision block
3. Identify Basic Types of Drawings
   a. Interpret information found in orthographic views
   b. Identify positions of views (top, front, side, and auxiliary)
   c. Visualize one or more views from a given view
   d. Identify isometric views
   e. Identify exploded isometric drawings
   f. Identify assembly drawings
4. Verify Drawing Elements
   a. Determine the scale of the view or section
   b. Check for revisions
   c. Recognize out-of-date blueprints
5. Practice Geometric Dimensioning and Tolerancing (GD&T) Methodology
   a. Identify the purpose of GD&T
   b. Identify symbols for controlling location (or true position) of part features
   c. Identify symbols for controlling form (or alignment) of part features
   d. Identify symbols for showing datums and basic dimensions on drawings
   e. Identify symbols for Maximum Material Size (MMS) and Regardless of Feature Size (RFS)
6. Describe the Relationship of Engineering Drawings to Planning
   a. Discuss production schedule
   b. Discuss Material Resource Planning (MRP)
   c. Discuss inventory control records
7. Analyze Bill of Materials (BOM)
   a. Discuss components found on BOM
   b. Determine materials needed to produce the part
   c. Determine quantities necessary to produce the part
   d. Submit completed stock request form as required
   e. Submit completed tool request form as needed

C. RECOGNIZE DIFFERENT MANUFACTURING MATERIALS & PROCESSES

1. Identify Materials With Desired Properties
   a. Discuss classification system for metals

D. PERFORM ADVANCED MACHINING PROCESSES

1. Prepare and Plan For CNC Machining Operations
   a. Read and interpret blueprints
   b. Plan CNC machining operations
   c. Calculate speeds, feeds, and depth of cut for various CNC machine applications
   d. Determine proper cutting fluids/coolants for CNC machining
   e. Use the Machinery's Handbook as a reference for CNC machine applications
2. Select and Use CNC Tooling Systems

a. Understand machinability and chip formation
b. Select proper insert materials and geometry
c. Assemble tooling components
d. Select correct tooling systems
e. Identify tooling cost factors

3. Program CNC Machines
   a. Identify CNC applications
   b. List various types of CNC machines
   c. Discuss CNC machine control systems
   d. Describe absolute and incremental coordinate systems
   e. Plan and write programs for CNC lathes
   f. Plan and write programs for CNC mills
4. Operate CNC Machining Centers (Mills)
   a. Install and align work holding devices
   b. Load/align materials into the machine
   c. Load tools into machine
   d. Establish tool length offset for each tool
   e. Establish/set machine reference
   f. Load programs into CNC mill
   g. Demonstrate working knowledge of all controls on the MCU
   h. Demonstrate proper operation of CNC machining center to include "dry run" and final production
   i. Edit CNC programs for optimum part production
   j. Operate machine in DNC mode if that capability exists
5. Download Programs Via Network
   a. Download programs from the network
   b. Upload programs to the network
   c. Perform edit and print functions via network
6. Program CNC Machines using a CAM system
   a. Create Job Plan for machining operations
   b. Construct part geometry
   c. Program tool path for roughing and finishing operations
   d. Verify tool path
   e. Generate CNC code

E. USE COMPUTERS

1. Use Computer Operating Systems
   a. Use basic computer terminology appropriately and accurately
   b. Boot the computer and recognize the basic components of DOS
   c. Use DOS to perform file management
   d. Use DOS to perform directory management

COURSE OBJECTIVES: SCANS COMPETENCIES

The Secretary's Commission on Achieving Necessary Skills (SCANS), U.S. Department of Labor, has identified in its "AMERICA 2000 REPORT" that all students should develop a new set of competencies and foundation skills if they are to enjoy a productive, full and satisfying life. These are in addition to the Technical Workplace Competencies required by industry. SCANS is

made up of five competencies and a three-part foundation of skills and personal qualities that are needed for solid job performance.

The following activities will be performed by each student for successful completion of this course:

I. **COMPETENCIES**

- *A.* ***Resources:*** *Identifies, organizes, plans, and allocates resources*
  1. follows a schedule to complete assigned tasks on time
  2. determine the initial cost of materials and "value added" as result of machining
  3. provide a self-evaluation of performance based on the time and quality of work
- *B.* ***Interpersonal:*** *Works with others*
  1. complete assigned responsibilities within the shop floor serving as a member of the team
  2. provide individual assistance/direction to peers as requested
  3. produce machine parts to acceptable levels of quality as required
  4. works well with all members of the class
- *C.* ***Information:*** *Acquires and uses information*
  1. read and interpret blueprints
  2. organize and apply theories of machine tool operation
- *D.* ***Systems:*** *Understands complex inter-relationships*
  1. demonstrate knowledge of the following systems:
     a. laboratory organization structure: physical and social
     b. organization of personnel and facilities on the shop floor
     c. systematic approach to the metal removal process
     d. dimensioning and measurement systems
     e. systematic organization of training materials
  2. monitors and corrects performance during
     a. the machining process
     b. adjustments of individual laboratory work schedule
     c. constantly evaluating the quality of work to achieve acceptable standards
     d. maintains record of evaluations and sets individual goals
- *E.* ***Technology:*** *Works with a variety of technologies*
  1. chooses procedure, tools and equipment required to produce a part
  2. applies appropriate procedures and uses appropriate tools and equipment to produce a machined part to acceptable standards
  3. maintains and troubleshoots equipment
     a. applies appropriate preventative maintenance
     b. when operating machines

II. **FOUNDATION SKILLS**

- *A.* ***Basic Skills:*** *Reads, writes, performs arithmetic and mathematical operations, listens and speaks.*

1. ***Reading:*** *Locates, understands, and interprets written information in prose and in documents such as manuals, graphs, and schedules*
   a. studies student laboratory manual
   b. interprets blueprints and technical drawings
   c. read/studies textbook
   d. follow a daily laboratory schedule to maintain appropriate time-line and product completion
2. ***Writing:*** *Communicates thoughts, ideas, information, and messages in writing; and creates documents such as letters, directions, manuals, reports, graphs, and flow charts*
   a. outline the steps necessary to produce a simple machine part
   b. maintain a lecture notebook
   c. submit written responses to chapter question assignments
   d. complete all written assignments
3. ***Arithmetic/Mathematics:*** *Perform basic computations and approaches practical problems by choosing appropriately from a variety of mathematical techniques*
   a. determines optimum machining speeds, feeds, and depth of cut
   b. calculates "value added to the part"
   c. taps and threads
   d. keeps a running computation of individual grade
   e. interconverts fractions to decimal expressions
4. ***Listening:*** *Receives, attends to, interprets, and responds to verbal messages and other cues*
   a. assimilate classroom instruction
   b. interpret and assimilate video instruction
   c. observe laboratory demonstrations
   d. seek and receive individualized instruction in the laboratory
5. ***Speaking:*** *Organizes ideas and communicates orally*
   a. participates in classroom discussions
   b. organize ideas and communicate specific questions to the instructor
   c. verbally affirms understanding of a concept, procedure, or required skill
   d. communicates with peers to ensure the smooth and safe operation of the laboratory

B. ***Thinking Skills:*** *Thinks creatively, makes decisions, solves problems, visualizes, knows how to learn and reasons.*
1. ***Decision Making:*** *Specifies goals and constraints, generates alternatives, considers risks, and evaluates and chooses best alternative*
   a. identifies personal goals
   b. identifies actions required to accomplish personal goals
2. ***Problem Solving:*** *Recognizes problems and devises and implements plan of action*
   a. makes daily accommodations to stay on schedule
   b. seeks additional instruction/clarification for assignment completion
   c. balances social and academic life/responsibilities
   d. accepts responsibility

3. ***Seeing Things In the Mind's Eye:*** *Organizes, and processes symbols, pictures, graphs, objects, and other information*
   a. interprets technical drawings
   b. interprets technical illustrations and symbols
   c. understands both written and verbal instructions
   d. assimilates process during instructor demonstrations
4. ***Knowing How to Learn:*** *Use efficient learning techniques to acquire and apply new knowledge and skills*
   a. demonstrate mastery of the basic skills and techniques
   b. use these sequential skills to support mastery of new skills
   c. understand the sequential nature of acquired skills and the subsequent knowledge application of new skills and techniques
5. ***Reasoning:*** *Discovers a rule or principle underlying the relationship between two or more objects and applies it when solving a problem*
   a. understands that practice may not make it perfect but it certainly will improve the skill of the operator
   b. understands that the quality of the product is a function of the time of the operation and the attitude and skill of the machinist
   c. understands the relationship between different metals and the tool applied to the metal surface and adjusts machining parameters accordingly

C. ***Personal Qualities:*** *Displays responsibility, self-esteem, sociability, self-management, and integrity and honesty.*
1. ***Responsibility:*** *Exerts a high level of effort and perseveres towards goal attainment*
   a. develops an understanding that in order to be successful you must be a "good" student
   b. develops an understanding that a "good" student is the one who is prompt to every class and has prepared for the day's work
   c. develops an understanding good students know what they are going to do in class and does not waste time
   d. develops a fine work-ethic
2. ***Self-Esteem:*** *Believes in own self-worth and maintains a positive view of self*
   a. learns to take pride in his or her work through positive reinforcement
   b. sees himself or herself as an asset to the class through continued contributions to the group and a shared common goal
   c. understands that an individual with a positive attitude and the belief in their own abilities will systematically seek solutions and be a valuable employee
3. ***Sociability:*** *Demonstrates understanding, friendliness, adaptability, empathy, and politeness in group settings*
   a. assist classmates in improving technical skills
   b. assist students with special needs as a peer mentor
   c. share laboratory resources (machines, tools and instructor's individual attention)

4. ***Self-Management:*** *Assesses self accurately, sets personal goals, monitors progress, and exhibits self-control*
   a. perform in-process quality checks on machined parts
   b. maintain a record of academic achievement (individual gradebook)
   c. make accommodations to laboratory schedules due to broken machines/tools
   d. accept the responsibility for self-management
5. ***Integrity/Honesty:*** *Chooses ethical courses of action*
   a. accept the responsibility for own actions
   b. exhibit personal honesty at all times
   c. accept the challenge of doing your own work in the laboratory, during examination, and on outside assignments
   d. understand the consequences of unethical behaviors

Appropriate Reference Materials:

1. SMARTCAM Advanced 3-D Machining Reference Manual
2. Technology of Machine Tools, 4th Ed. McGraw Hill Publishers
3. Machine Tool Catalogs

MET301
01/072396

***M*achine Tool *A*dvanced *S*kills**
***T*echnology Program**

MAST

COURSE SYLLABUS

TOOL DESIGN I

Prerequisite: MACHINE TOOL PRACTICES I

MAST PROGRAM
COURSE SYLLABUS
TOOL DESIGN I

Lecture hours/week: 2 **Lab hours/week: 3** **Credit hours: 3**

COURSE DESCRIPTION:

Students will be assigned specific machining problems involving tool and die design concepts. These projects will be machined using the engine lathe, milling machine, drill press, band saws, surface grinders and various hand tools. Design simplification thru utilization of commercially available hardware vs. special non standard items and the safe use of machine tools will be stressed.

PREREQUISITES: **Machine Tool Practices I and Drafting Principles**

REQUIRED COURSE MATERIALS:

Textbook: **Machine Tool Practices**, Kibbe, Neely, and Meyer, Wiley Pub., 4th Ed.
Tool Design, LeCain & Goold, published by McGraw-Hill Pub., 4th Ed.

Hand Tools/Quantity Required:

Tool Box	1
Safety Glasses	1 pair
6 inch Ruler	1/8, 1/16, 1/32, and 1/64 inch
Ball Peen Hammer	1
10 inch Adjustable Wrench	1
Center Punch	1
Magic marker, Jumbo, black.	1
Aluminum Oxide Cloth, 9" X 11", 240 Grit	2 sheets
Aluminum Oxide Cloth, 9" X 11", 320 Grit	2 sheets
Tool Steel, 3/8", H.S.S.	2
Flat Mill Bastard File, 10 inch.	1
File Handle	1
Allen Wrench Set, Long English and Metric	1 each
Center Drill #3	1
Scribe	1
Center Gage	1
Screw Driver, 8 inch	1
File Card Brush	1
0-6 inch Dial Calipers	1
Shop Apron (blue denim)	1
Shop Towels (1 roll)	1

METHODS OF INSTRUCTION:

Lecture: Didactic presentations will include lecture, video and demonstrations.

Laboratory: Laboratory will be "hands-on" activities.

Method of Evaluation: A student's grade will be based on multiple measures of performance. The assessment will measure development of independent critical thinking skills and will include evaluation of the student's ability to:

1. perform the manipulative skills of the craft as required to satisfactorily complete laboratory assignments
2. apply theories of design considerations to laboratory assignments involving design and production of jigs, fixtures and other production tooling
3. demonstrate a knowledge of alternate manufacturing processes by selecting processes that reduce or eliminate primary and/or secondary machining operations
4. satisfactorily perform on written, oral, and practical examinations
5. satisfactorily perform on outside assignments including writing assignments
6. contribute to class discussions
7. maintain attendance per current policy
8. follow all shop rules and safety regulations as stated in the laboratory manual

LECTURE OUTLINE:

	Lecture Topics	Text Reference Page	Contact Hrs.
Unit 1	Introduction to Tool Design	1-5TD	
Unit 2	Safety	1-13MTP	
Unit 3	Tool Grinding	436-443MTP	
Unit 4	Review Measuring Tools	113-186MTP	
Unit 5	Review Machine Tools and Operations		
5.01	The Drill Press	365-402MTP	
5.02	Engine Lathes	429-535MTP	
5.03	Vertical Milling Machines	553-577MTP	
Unit 6	Introduction to Surface Grinding	671-719MTP	
Unit 7	Special Tooling	26-112TD	
Unit 8	Problems Resulting from Design	3-6TD	
Unit 9	Toolmaker Practices	26-128TD	
Unit 10	Tooling Materials and Heat Treatment	162-202TD	
Unit 11	Location and Clamping Methods	493-515TD	
Unit 12	Design of Drill Jigs	540-564TD	
Unit 13	Design of Fixtures	573-604TD	
Unit 14	Using Standard vs. Non-Standard Parts		
		Total Lecture Hours	**36**

LAB OUTLINE:

Lab Topics	Contact Hrs.
Identifying Design Problems	10
Solving Manufacturing Problems	24
Evaluating the Design Considerations	2
Total Lab Hours	**36**

COURSE OBJECTIVES: TECHNICAL COMPETENCIES

After the successful completion of this course the student will be able to:

A. PRACTICE SAFETY

1. Follow Safety Manuals and All Safety Regulations/Requirements
   a. Assume responsibility for the personal safety of oneself and others
   b. Develop a personal attitude towards safety
   c. Interpret safety manual directives
   d. Comply with established company safety practices
   e. Complete forms/paperwork as required
2. Use Protective Equipment
   a. Wear protective safety clothing as required
   b. Maintain and use protective guards and equipment on machinery
   c. Locate and properly use protective equipment
   d. Use lifting aids when necessary
3. Follow Safe Operating Procedures for Hand and Machine Tools
   a. Identify and understand safe machine operating procedures
   b. Demonstrate safe machine operation
4. Maintain a Clean and Safe Work Environment
   a. Keep work areas clean
   b. Clean machine/hand tools when work is completed
   c. Put tools away when work is finished
   d. Keep aisles clear of equipment and materials
   e. Perform preventative maintenance as required
5. Apply Ergonomic Principles to the Workplace
   a. Define ergonomics
   b. Explain the characteristics and potential impact of ergonomics on design, productivity, and safety

B. INTERPRET ENGINEERING DRAWINGS AND CONTROL DOCUMENTS

1. Review Blueprint Notes and Dimensions
   a. Explain basic blueprint terminology
   b. Identify the types of dimensions
   c. Identify general note symbols
   d. Locate notes on a print
   e. Interpret commonly used abbreviations and terminology
   f. Determine tolerances associated with dimensions on a drawing
   g. Determine the tolerance for a reference dimension
   h. Determine the surface finish for a given part
   i. List the essential components found in the general drawing notes

2. Identify Basic Layout of Drawings
   a. Identify types of lines within a drawing
   b. Identify item number symbols
   c. Identify general note symbols
   d. List the essential components found in the title block
   e. Locate bill of materials in a drawing
   f. List the components found in the revision block
3. Identify Basic Types of Drawings
   a. Identify orthographic views
   b. Identify positions of views (top, front, side, and auxiliary)
   c. Visualize one or more views from a given view
   d. Identify isometric views
   e. Identify exploded isometric drawings
   f. Identify assembly drawings
4. List the Purpose of Each Type of Drawing
   a. Discuss purpose of orthographic (3 views) drawings
   b. Discuss purpose of isometric drawing
   c. Discuss purpose of exploded isometric drawing
   d. Discuss purpose of assembly drawings
5. Verify Drawing Elements
   a. Determine the scale of the view or section
   b. Check for revisions
   c. Recognize out-of-date blueprints
6. Practice Geometric Dimensioning and Tolerancing (GD&T) Methodology
   a. Identify the purpose of GD&T
   b. Identify symbols for controlling location (or true position) of part features
   c. Identify symbols for controlling form (or alignment) of part features
   d. Identify symbols for showing datums and basic dimensions on drawings
   e. Identify symbols for Maximum Material Size (MMS) and Regardless of Feature Size (RFS)
7. Describe the Relationship of Engineering Drawings to Planning
   a. Discuss production schedule
   b. Discuss Material Resource Planning (MRP)
   c. Discuss inventory control records
   d. Discuss shop floor routing documents
8. Use Standards to Verify Requirements
   a. Discuss the purpose of standards
   b. Discuss source locations for standards
9. Analyze Bill of Materials (BOM)
   a. Discuss components found on BOM
   b. Determine materials needed to produce the part
   c. Determine quantities necessary to produce the part
   d. Submit completed stock request form as required
   e. Submit completed tool request form as needed
10. Understand and Use Quality Systems
   a. Describe ISO 9000 quality system
   b. Document paper trails for document revisions

C. RECOGNIZE DIFFERENT MANUFACTURING MATERIALS AND PROCESSES

1. Identify Materials With Desired Properties
   a. Discuss classification system for metals
   b. Discuss general characteristics for carbon steels, tool steels, stainless steels, structural steels, cast irons, aluminum, and other commonly used metals
   c. List advantages for considering plastic as a viable materials choice
   d. List the advantages and disadvantages for each of the following plastic molding processes: blow, injection, vacuum, extrusion, etc.
   e. Discuss the advantages for using composites in various manufacturing applications
2. Identify Materials and Processes to Produce a Product
   a. Discuss service requirements (in strength, hardness, etc.)
   b. Discuss fastening processes (i.e., fasteners, welding, bonding, etc.)
   c. Discuss corrosion resistance methods
3. Describe Heat Treating Processes
   a. Discuss the reasons for heat treating
   b. Discuss the time/temperature chart
   c. List the different quenching mediums
   d. Estimate metal heat temperature by color
   e. List reasons for stress relieving workpieces
   f. Discuss surface hardening processes
4. Perform Heat Treating Operations
   a. Harden plain carbon workpiece
   b. Temper plain carbon workpiece
   c. Anneal plain carbon workpiece
   d. Case harden workpiece
5. Test Metal Samples for Hardness
   a. Perform spark test to test for metal hardness
   b. Perform Rockwell hardness tests

D. DEMONSTRATE MEASUREMENT/INSPECTION TECHNIQUES

1. Identify Types of Measurement Used in Manufacturing
   a. Distinguish between direct and calculated measurements
   b. Compute calculated measurements
   c. Justify the use of precision measurements in manufacturing
   d. Discuss the following: precision, reliability and accuracy
   e. Demonstrate general measurement techniques
   f. Demonstrate semi-precision measurement techniques
   g. Demonstrate precision measurement techniques
   h. Document results of measurement activities and calculations
2. Select Proper Measurement Tools
   a. Match appropriate measurement tools with various types of measurement requirements
   b. Demonstrate proper measurement tool usage
   c. List steps of proper measurement
   d. Explain rationale for each step
   e. Identify error possibilities in measurement tool selection

f. Identify error possibilities within measurement procedures
g. Identify common conversion error possibilities
h. Discriminate between accepted measurement procedures and improper measurement procedures

3. Apply Proper Measuring Techniques
   a. Explain calibration requirements of various precision instruments
   b. Illustrate measurement differences when taken with calibrated and non-calibrated instruments
   c. Justify use of particular measurement tools based on tool characteristics
   d. Discuss factors affecting accurate measurement (e.g., dirt, temperature)
4. Perform Measurements With Hand Held Instruments
   a. Measure with steel rules (metric and inch)
   b. Measure with micrometers
   c. Measure with comparison measuring instruments (e.g., calipers, telescope gages)
   d. Measure with direct measuring instruments (e.g., vernier, dial, and digital instruments)
5. Perform Measurements on Surface Plate
   a. Describe care of surface plate
   b. Use surface plate accessories correctly (sine bar, gage blocks, etc.)
   c. Check for part squareness
   d. Check part dimensions for accuracy
   e. Align workpieces using height gage and dial indicators

E. PERFORM CONVENTIONAL MACHINING OPERATIONS

1. Prepare and Plan For Machining Operations
   a. Read and interpret blueprints
   b. Perform basic semi-precision and precision layout as necessary
   c. Plan machining operations
   d. Understand machinability and chip formation
   e. Calculate speeds, feeds, and depth of cut for various machine applications
   f. Determine proper cutting fluids/coolants for machining
   g. Use carbides and other tool materials to increase productivity
   h. Use the Machinery's Handbook as a reference for machine applications
2. Use Proper Hand Tools
   a. Use arbor and shop presses
   b. Select necessary work-holding devices and hand tools as needed
   c. Select and use hand files
   d. Identify and use hand reamers
   e. Correctly identify and use hand taps as required
   f Follow tapping procedures to produce internal threads
   g. Use thread-cutting dies to produce external threads
   h. Operate bench and pedestal grinders safely
3. Operate Power Saws
   a. Use reciprocating and horizontal band cutoff machines
   b. Operate abrasive and cold saws
   c. Prepare and use the vertical band saw
   d. Weld a bandsaw blade

4. Operate Drill Presses
    a. Describe the different types of drill presses found in the machine shop
    b. Describe and use standard drilling tools
    c. Sharpen a drill bit using a bench or pedestal grinder
    d. Setup the drill presses for drilling, countersinking, counterboring, reaming, and tapping operations
    e. Drill holes using drill jigs
5. Operate Vertical Milling Machines
    a. Demonstrate the use of all controls on the vertical milling machine
    b. Align the vertical milling machine head
    c. Select, align and use workholding devices
    d. Select milling tool holders
    e. Select milling cutters
    f. Perform all standard vertical milling operations
    g. Bore a hole using the offset boring head
    h. Machine angles using sine bar and gage blocks
    i. Setup and use special vertical mill fixtures
    j. Setup and machine dovetails
    k. Machine keyways
6. Operate Horizontal Milling Machines
    a. Discuss the difference in plain and universal horizontal milling machines
    b. Discuss the types of spindles, arbors and adaptors used on the horizontal milling machine
    c. List several common work holding methods
    d. Use plain milling cutters
    e. Use side milling cutters
    f. Use face milling cutters
    g. Setup and use special horizontal mill fixtures
7. Operate Metal Cutting Lathes
    a. Demonstrate the use of all controls on the engine lathe
    b. Discuss standard tools and toolholders for the lathe
    c. Face and center drill parts correctly
    d. Drill, ream and bore on the lathe
    e. Turn between centers
    f. Discuss alignment of lathe centers
    g. Make all calculations, lathe adjustments and settings to machine sixty-degree internal and external threads
    h. Discuss thread fit classifications
    i. Make all calculations, lathe adjustments and settings to machine an Acme thread
    j. Describe the common tapers used in the machine shop
    k. Discuss taper cutting and calculations for the lathe
    l. Setup and use the taper attachment found on most lathes
    m. Use follower rests and steady rests
    n. Use HSS cutting tools
    o. Use carbide cutting tools
    p. Setup and operate tracer lathes

q. Setup and operate turret lathes

8. Operate Grinding/Abrasive Machines
   a. Discuss the selection and identification of grinding wheels
   b. Inspect, mount, true, dress, and balance grinding wheels
   c. Discuss the selection of grinding fluids
   d. Operate horizontal spindle reciprocating table surface grinders
   e. Operate cylindrical grinders
   f. Operate ID and OD grinders
   g. Setup and operate tool and cutter grinders
   h. Discuss common problems and solutions in surface grinding
   i. Operate honing machine
   j. Operate lapping machines

F. PERFORM WELDING OPERATIONS

1. Weld With Shielded Metal Arc Welding (SMAW) Process
   a. Discuss factors for welding electrode selection
   b. Adjust welding amperage setting for each application
   c. Demonstrate proper use of safety equipment
   d. Weld beads on plate (flat, horizontal, and vertical)
   e. Weld tee joints (flat, horizontal, and vertical)
   f. Weld pipe joints
   g. Discuss weld inspection factors and techniques

2. Weld/Cut With Oxyacetylene
   a. Setup and break down the oxyacetylene welding/cutting station
   b. Discuss proper settings for oxyacetylene regulators
   c. Discuss factors that determine torch welding and cutting tip selection
   d. Demonstrate routine torch maintenance procedures
   e. Weld beads on plate (with and without filler) in the flat and horizontal positions
   f. Weld square groove butt joints in the flat and horizontal positions
   g. Braze weld beads on plate in the flat position
   h. Make square cuts to a straight line with the cutting torch
   i. Demonstrate proper use of safety equipment

G. PERFORM DRAFTING TASKS.

1. Demonstrate Traditional Mechanical Drafting Skills
   a. Form freehand vertical Gothic upper-case letters and numerals of correct shape and space
   b. Execute the alphabet of lines correctly, producing dense black lines of uniform thickness and spacing
   c. Demonstrate proficiency with the engineers and metric scales
   d. Execute geometric constructions with no mistakes in tangent points, line quality or layout work
   e. Accurately draw the missing view or line in a multiview drawing
   f. Make or complete a sectional instrument drawing, given one or more views
   g. Develop satisfactory working drawings of simple machine components to include all necessary views and dimensions for complete shape and size description of detail parts
   h. Discuss the differences in standard engineering drawings and tool drawings

i. Develop satisfactory tool drawings for drill jigs, milling fixture, and inspection fixtures

2. Make Tool Drawings
   a. Discuss the differences in tool drawings verses regular mechanical drawings
   b. Design and draw a simple drill jig using accepted practices
   c. Design and draw a simple milling fixture using accepted practices

COURSE OBJECTIVES: SCANS COMPETENCIES

The Secretary's Commission on Achieving Necessary Skills (SCANS), U.S. Department of Labor, has identified in its "AMERICA 2000 REPORT" that all students should develop a new set of competencies and foundation skills if they are to enjoy a productive, full and satisfying life. These are in addition to the Technical Workplace Competencies required by industry. SCANS is made up of five competencies and a three-part foundation of skills and personal qualities that are needed for solid job performance.

The following activities will be performed by each student for successful completion of this course:

I. **COMPETENCIES**

A. ***Resources:*** *Identifies, organizes, plans, and allocates resources*
   1. follows a schedule to complete assigned tasks on time
   2. determine the initial cost of materials and "value added" as result of machining
   3. complete a stock request form for required material
   4. provide a self-evaluation of performance based on the time and quality of work

B. ***Interpersonal:*** *Works with others*
   1. complete assigned responsibilities within the shop floor serving as a member of the team
   2. provide individual assistance/direction to peers as requested
   3. produce tools and fixtures to acceptable levels of quality as required
   4. works well with all members of the class

C. ***Information:*** *Acquires and uses information*
   1. read and interpret blueprints
   2. organize and apply theories of tool design
   3. perform basic semi-precision and precision layout as necessary

D. ***Systems:*** *Understands complex inter-relationships*
   1. demonstrate knowledge of the following systems:
      a. laboratory organization structure: physical and social
      b. organization of personnel and facilities on the shop floor
      c. systematic approach to the metal removal process
      d. dimensioning and measurement systems

e. systematic organization of training materials

2. monitors and corrects performance during
   a. the machining process
   b. adjustments of individual laboratory work schedule
   c. constantly evaluating the quality of work to achieve acceptable standards
   d. maintains record of evaluations and sets individual goals

E. ***Technology:*** *Works with a variety of technologies*

1. chooses procedure, tools and equipment required to produce a part
2. applies appropriate procedures and uses appropriate tools and equipment to produce a machined part to acceptable standards
3. maintains and troubleshoots equipment
   a. applies appropriate preventative maintenance
   b. when operating machines
   c. reports all malfunctions of equipment to supervisor/instructor
   d. perform clean-up assignments of machine and shop floor at the end of the laboratory

II. FOUNDATION SKILLS

A. ***Basic Skills:*** *Reads, writes, performs arithmetic and mathematical operations, listens and speaks.*

1. ***Reading:*** *Locates, understands, and interprets written information in prose and in documents such as manuals, graphs, and schedules*
   a. studies student laboratory manual
   b. interprets blueprints and technical drawings
   c. read/studies textbook
   d. follow a daily laboratory schedule to maintain appropriate time-line and product completion

2. ***Writing:*** *Communicates thoughts, ideas, information, and messages in writing; and creates documents such as letters, directions, manuals, reports, graphs, and flow charts*
   a. outline the steps necessary to produce a simple machine part
   b. maintain a lecture notebook
   c. submit written responses to chapter question assignments
   d. complete all written assignments

3. ***Arithmetic/Mathematics:*** *Perform basic computations and approaches practical problems by choosing appropriately from a variety of mathematical techniques*
   a. determines optimum machining speeds, feeds, and depth of cut
   b. calculates "value added to the part"
   c. aligns machine and/or work holding device
   d. taps and threads
   e. keeps a running computation of individual grade
   f. interconverts fractions to decimal expressions
   g. use protractors to lay-out angle machining
   h. use trigonometry to solve angle and taper calculations

4. ***Listening:*** *Receives, attends to, interprets, and responds to verbal messages and other cues*
   a. assimilate classroom instruction
   b. interpret and assimilate video instruction
   c. observe laboratory demonstrations
   d. seek and receive individualized instruction in the laboratory
5. ***Speaking:*** *Organizes ideas and communicates orally*
   a. participates in classroom discussions
   b. organize ideas and communicate specific questions to the instructor
   c. verbally affirms understanding of a concept, procedure, or required skill
   d. communicates with peers to ensure the smooth and safe operation of the laboratory

B. ***Thinking Skills:*** *Thinks creatively, makes decisions, solves problems, visualizes, knows how to learn and reasons.*

1. ***Decision Making:*** *Specifies goals and constraints, generates alternatives, considers risks, and evaluates and chooses best alternative*
   a. identifies personal goals
   b. identifies actions required to accomplish personal goals
2. ***Problem Solving:*** *Recognizes problems and devises and implements plan of action*
   a. use tool design concepts to design a tool which will work acceptably
   b. seeks additional instruction/clarification for assignment completion
   c. balances social and academic life/responsibilities
   d. accepts responsibility
3. ***Seeing Things In the Mind's Eye:*** *Organizes, and processes symbols, pictures, graphs, objects, and other information*
   a. interprets technical drawings
   b. interprets technical illustrations and symbols
   c. understands both written and verbal instructions
   d. assimilates process during instructor demonstrations
4. ***Knowing How to Learn:*** *Use efficient learning techniques to acquire and apply new knowledge and skills*
   a. demonstrate mastery of the basic skills and techniques
   b. use these sequential skills to support mastery of new skills
   c. understand the sequential nature of acquired skills and the subsequent knowledge application of new skills and techniques
5. ***Reasoning:*** *Discovers a rule or principle underlying the relationship between two or more objects and applies it when solving a problem*
   a. understands that practice may not make it perfect but it certainly will improve the skill of the operator
   b. understands that the quality of the product is a function of the time of the operation and the attitude and skill of the machinist
   c. understands the relationship between different metals and the tool applied to the metal surface and adjusts machining parameters accordingly

C. ***Personal Qualities:*** *Displays responsibility, self-esteem, sociability, self-management, and integrity and honesty.*

1. ***Responsibility:*** *Exerts a high level of effort and perseveres towards goal attainment*
   a. develops an understanding that in order to be successful you must be a "good" student
   b. develops an understanding that a "good" student is the one who is prompt to every class and has prepared for the day's work
   c. develops an understanding good students know what they are going to do in class and does not waste time
   d. develops a fine work-ethic
2. ***Self-Esteem:*** *Believes in own self-worth and maintains a positive view of self*
   a. learns to take pride in his or her work through positive reinforcement
   b. sees himself or herself as an asset to the class through continued contributions to the group and a shared common goal
   c. understands that an individual with a positive attitude and the belief in their own abilities will systematically seek solutions and be a valuable employee
3. ***Sociability:*** *Demonstrates understanding, friendliness, adaptability, empathy, and politeness in group settings*
   a. assist classmates in improving technical skills
   b. assist students with special needs as a peer mentor
   c. share laboratory resources (machines, tools and instructor's individual attention)
4. ***Self-Management:*** *Assesses self accurately, sets personal goals, monitors progress, and exhibits self-control*
   a. perform in-process quality checks on machined parts
   b. maintain a record of academic achievement (individual grade book)
   c. make accommodations to laboratory schedules due to broken machines/tools
   d. accept the responsibility for self-management
5. ***Integrity/Honesty:*** *Chooses ethical courses of action*
   a. accept the responsibility for own actions
   b. exhibit personal honesty at all times
   c. accept the challenge of doing your own work in the laboratory, during examination, and on outside assignments
   d. understand the consequences of unethical behaviors

Appropriate Reference Materials:

1. Tool Design, 4th Edition, Donaldson, Lecain, and Gold. McGraw Hill Pub.
2. Technology of Machine Tools, 4th Ed. McGraw Hill Publishers
3. Machinery's Handbook, Industrial Press

***M*achine Tool *A*dvanced *S*kills**
***T*echnology Program**

MAST

COURSE SYLLABUS

STRENGTH OF MATERIALS

200

MAST PROGRAM
COURSE SYLLABUS
STRENGTH OF MATERIALS

Lecture hours/week: 3 **Lab hours/week: 3** **Credit hours: 4**

COURSE DESCRIPTION:

This is a course designed to give the student a basic understanding of the internal stresses and deformation of elastic bodies resulting from the action of external forces. The student should be able to: determine internal stresses due to external loads, make calculations for riveted joints with specified loads, analyze welded joints, determine the centroid and moment of inertia of a built-up section.

PREREQUISITES: **Statics**

REQUIRED COURSE MATERIALS:

Textbook: Applied Statics and Strength of Materials, Spiegel and Limbunner, Merrill Publishers
Lab Manual: NONE

Required Materials: Engineering paper, green
Scientific Calculator

METHODS OF INSTRUCTION:

Lecture: Didactic presentations will include lecture, video and demonstrations.

Laboratory: Laboratory assignments will require student to solve appropriate problems involving the mechanical and physical properties of various materials.

Method of Evaluation: A student's grade will be based on multiple measures of performance. The assessment will measure development of independent critical thinking skills and will include evaluation of the student's ability to:

1. perform the manipulative skills of the craft as required to satisfactorily complete laboratory assignments
2. apply theory to laboratory assignments
3. satisfactorily perform on written, oral, and practical examinations
4. satisfactorily perform on outside assignments including writing assignments
5. contribute to class discussions
6. maintain attendance per current policy

LECTURE OUTLINE:

	Lecture Topics	Text Reference Page	Contact Hrs.
1	**Centroids and Centers of Gravity** (Review from MET 205)		
.01	Center of Gravity	182	
1.02	Centroids and Centroidal Axes	185	
1.03	Centroids and Centodial Axes of Composite Areas	186	
2	**Area Moments of Inertia**		
2.01	Terms and Definitions	201	
2.02	Moments of Inertia	203	
2.03	The Transfer Formula	207	
2.04	Moments of Inertia of Composite Areas	208	
2.05	Radius of Gyration	216	
2.06	Polar Moment of Inertia	218	
2.07	Chapter Review	221	
3	**Stresses and Strains**		
3.01	Tensile and Compressive Stresses	227	
3.02	Shear Stresses	234	
3.03	Tensile and Compressive Strain and Deformation	239	
3.04	Shear Strain	241	
3.05	The Relationship Between Stress and Strain (Hooke's Law)	242	
3.06	Chapter 9 Summary	249	
4	**Torsion in Circular Sections**		
4.01	Introduction	316	
4.02	Torsional Shear Stress	320	
4.03	Angle of Twist	328	
4.04	The Transmission of Power by Shafts	332	
4.05	Chapter 12 Summary	336	
5	**Shear and Bending Moments in Beams**		
5.01	Types of Beams and Supports	343	
5.02	Types of Loads on Beams	346	
5.03	Beam Reactions	347	
5.04	Shear Force and Bending Moments	352	
5.05	Shear Diagrams	360	
5.06	Moment Diagrams	371	
5.07	Sections of Maximum Moment	377	
5.08	Moving Loads	381	
5.09	Chapter 13 Summary	385	
6	**Stresses in Beams**		
6.01	Tensile and Compressive Stresses Due to Bending	395	
6.02	The Flexure Formula	397	
6.03	Computation of Bending Stresses	401	
6.04	Shear Stresses	407	

6.05	The General Shear Formula	408
6.06	Shear Stresses in Structural Members	411
6.07	Beam Analysis	421
6.08	Chapter 14 Summary	426
7	**Design of Beams**	
7.01	The Design Process	437
7.02	The Design of Steel Beams	440
7.03	The Design of Timber Beams	450
7.04	Chapter 15 Summary	459
8	**Review and Testing**	
	Total Lecture Hours	**36**

LAB OUTLINE:

Lab Topics	Contact Hrs.
Area Moments of Inertia (Chapter 8, Problems 1, 2, 7, 9, and 22)	4
Stresses and Strains (Chapter 9, Problems 2, 4, 7, 8, 12, 13, 14, 16, 25, and 28)	8
Torsion in Circular Sections (Chapter 12, Problems 1-6, 11, 12, 14, and 24)	8
Shear and Bending Moments in Beams (Chapter 13, Problems 2, 4, 6, 10, 12, 13, 15, 16, 17, and 18)	8
Stresses in Beams (Chapter 14, Problems 3, 5, 8, 9, 11, 15, and 32)	4
Design of Beams (Chapter 15, Problems 2, 4, 5, 6, and 12)	4
Total Lab Hours	**36**

COURSE OBJECTIVES: TECHNICAL COMPETENCIES

After the successful completion of this course the student will be able to:

A. PRACTICE SAFETY

1. Follow Safety Manuals and All Safety Regulations/Requirements
   a. Assume responsibility for the personal safety of oneself and others
   b. Develop a personal attitude towards safety
   c. Interpret safety manual directives
   d. Comply with established company safety practices
2. Use Protective Equipment
   a. Wear protective safety clothing as required
   b. Maintain and use protective guards and equipment on machinery
   c. Locate and properly use protective equipment
   d. Use lifting aids when necessary
3. Follow Safe Operating Procedures for Hand and Machine Tools
   a. Identify and understand safe machine operating procedures
   b. Demonstrate safe machine operation
4. Maintain a Clean and Safe Work Environment
   a. Keep work areas clean
   b. Clean machine/hand tools when work is completed
   c. Put tools away when work is finished

d. Keep aisles clear of equipment and materials

B. APPLY MATHEMATICAL CONCEPTS

1. Perform Basic Arithmetic Functions
   a. Add, subtract, multiply and divide whole numbers
   b. Add, subtract, multiply, and divide fractions
   c. Add, subtract, multiply, and divide decimals
2. Interconvert Fractions/Decimals
   a. Convert fractions to decimal equivalents
   b. Convert decimal values to nearest fractional equivalent
   c. Use Decimal Equivalent Chart for conversions
3. Interconvert Metric/English measurements
   a. Convert English dimensions to Metric
   b. Convert Metric dimensions to English
   c. Use Metric/English conversion chart
4. Perform Basic Trigonometric Functions
   a. Solve for unknown angles
   b. Solve for unknown sides
5. Solve Static Systems for Resultant Forces
   a. Solve for the following coplanar force systems: parallel, concurrent and nonconcurrent
   b. Solve for the following noncoplanar force systems: parallel, concurrent and nonconcurrent
6. Solve Engineering Equations
   a. Solve linear algebraic equations for an unknown
   b. Solve a system of linear equations with two unknowns
   c. Solve right triangles for unknown sides or angles
   d. Use the law of sines and cosines to solve obtuse triangles with unknown sides and angles
   e. Calculate factors of friction
7. Use All Functions of a Scientific Calculator
   a. Apply all trigonometric functions
   b. Apply all algebraic functions
   c. Apply all statistical functions
8. Determine Strengths of Materials for Various Applications
   a. Discuss stress and deformation
   b. List properties of materials (e.g., strength, elasticity, stiffness, ductility, hardness)
   c. Calculate stresses and design of joints
   d. Discuss advantages and disadvantages of different fastening technique
   e. Discuss problems related to torque-twisting moments
   f. Discuss centroids and moments of inertia of areas

C. INTERPRET ENGINEERING DRAWINGS AND CONTROL DOCUMENTS

1. Review Blueprint Notes and Dimensions
   a. Explain basic blueprint terminology
   b. Identify the types of dimensions
   c. Identify general note symbols
   d. Locate notes on a print

e. Interpret commonly used abbreviations and terminology
f. Determine tolerances associated with dimensions on a drawing
g. Determine the tolerance for a reference dimension
h. Determine the surface finish for a given part
i. List the essential components found in the general drawing notes

COURSE OBJECTIVES: SCANS COMPETENCIES

The Secretary's Commission on Achieving Necessary Skills (SCANS), U.S. Department of Labor, has identified in its "AMERICA 2000 REPORT" that all students should develop a new set of competencies and foundation skills if they are to enjoy a productive, full and satisfying life. These are in addition to the Technical Workplace Competencies required by industry. SCANS is made up of five competencies and a three-part foundation of skills and personal qualities that are needed for solid job performance.

The following activities will be performed by each student for successful completion of this course:

I. **COMPETENCIES**

A. Resources: Identifies, organizes, plans, and allocates resources
1. follows a schedule to complete assigned tasks on time
2. determine the initial cost of materials and "value added" as result of machining
3. complete a stock request form for required material
4. provide a self-evaluation of performance based on the time and quality of work

B. Interpersonal: Works with others
1. complete assigned responsibilities within the shop floor serving as a member of the team
2. provide individual assistance/direction to peers as requested
3. works well with all members of the class

C. Information: Acquires and uses information
1. read and interpret blueprints
2. organize and apply theories of machine tool operation

D. Systems: Understands complex inter-relationships
1. demonstrate knowledge of the following systems:
   a. laboratory organization structure: physical and social
   b. organization of personnel and facilities on the shop floor
   c. systematic approach to the metal removal process
   d. dimensioning and measurement systems
   e. systematic organization of training materials
2. monitors and corrects performance during
   a. application of statics principles and structural analysis
   b. adjustments of individual laboratory work schedule

c. constantly evaluating the quality of work to achieve acceptable standards
d. maintains record of evaluations and sets individual goals

E. ***Technology:*** *Works with a variety of technologies*
1. uses a scientific calculator
2. applies appropriate procedures and uses appropriate hardware and software

II. FOUNDATION SKILLS

A. ***Basic Skills:*** *Reads, writes, performs arithmetic and mathematical operations, listens and speaks.*

1. ***Reading:*** *Locates, understands, and interprets written information in prose and in documents such as manuals, graphs, and schedules*
a. studies student laboratory manual
b. interprets blueprints and technical drawings
c. read/studies textbook
d. follow a daily laboratory schedule to maintain appropriate time-line and product completion

2. ***Writing:*** *Communicates thoughts, ideas, information, and messages in writing; and creates documents such as letters, directions, manuals, reports, graphs, and flow charts*
a. outline the steps necessary to produce a simple machine part
b. maintain a lecture notebook
c. submit written responses to chapter question assignments
d. complete all written assignments

3. ***Arithmetic/Mathematics:*** *Perform basic computations and approaches practical problems by choosing appropriately from a variety of mathematical techniques*
a. determines optimum machining speeds, feeds, and depth of cut
b. calculates "value added to the part"
c. aligns machine and/or work holding device
d. taps and threads
e. keeps a running computation of individual grade
f. interconverts fractions to decimal expressions
g. use protractors to lay-out angle machining
h. use trigonometry to solve angle and taper calculations

4. ***Listening:*** *Receives, attends to, interprets, and responds to verbal messages and other cues*
a. assimilate classroom instruction
b. interpret and assimilate video instruction
c. observe laboratory demonstrations
d. seek and receive individualized instruction in the laboratory

5. ***Speaking:*** *Organizes ideas and communicates orally*
a. participates in classroom discussions
b. organize ideas and communicate specific questions to the instructor
c. verbally affirms understanding of a concept, procedure, or required skill

d. communicates with peers to ensure the smooth and safe operation of the laboratory

B. ***Thinking Skills:*** *Thinks creatively, makes decisions, solves problems, visualizes, knows how to learn and reasons.*

1. ***Decision Making:*** *Specifies goals and constraints, generates alternatives, considers risks, and evaluates and chooses best alternative*
   a. identifies personal goals
   b. identifies actions required to accomplish personal goals
2. ***Problem Solving:*** *Recognizes problems and devises and implements plan of action*
   a. makes daily accommodations to stay on schedule
   b. seeks additional instruction/clarification for assignment completion
   c. balances social and academic life/responsibilities
   d. accepts responsibility
3. ***Seeing Things In the Mind's Eye:*** *Organizes, and processes symbols, pictures, graphs, objects, and other information*
   a. interprets technical drawings
   b. interprets technical illustrations and symbols
   c. understands both written and verbal instructions
   d. assimilates process during instructor demonstrations
4. ***Knowing How to Learn:*** *Use efficient learning techniques to acquire and apply new knowledge and skills*
   a. demonstrate mastery of the basic skills and techniques
   b. use these sequential skills to support mastery of new skills
   c. understand the sequential nature of acquired skills and the subsequent knowledge application of new skills and techniques
5. ***Reasoning:*** *Discovers a rule or principle underlying the relationship between two or more objects and applies it when solving a problem*
   a. understands that practice may not make it perfect but it certainly will improve the skill of the operator
   b. understands that the quality of the product is a function of the time of the operation and the attitude and skill of the machinist
   c. understands the relationship between different materials and the principles of statics and mechanics applied to these materials

C. ***Personal Qualities:*** *Displays responsibility, self-esteem, sociability, self-management, and integrity and honesty.*

1. ***Responsibility:*** *Exerts a high level of effort and perseveres towards goal attainment*
   a. develops an understanding that in order to be successful you must be a "good" student
   b. develops an understanding that a "good" student is the one who is prompt to every class and has prepared for the day's work
   c. develops an understanding good students know what they are going to do in class and does not waste time
   d. develops a fine work-ethic
2. ***Self-Esteem:*** *Believes in own self-worth and maintains a positive view of self*

a. learns to take pride in his or her work through positive reinforcement
b. sees himself or herself as an asset to the class through continued contributions to the group and a shared common goal
c. understands that an individual with a positive attitude and the belief in their own abilities will systematically seek solutions and be a valuable employee

3. ***Sociability:*** *Demonstrates understanding, friendliness, adaptability, empathy, and politeness in group settings*
   a. assist classmates in improving technical skills
   b. assist students with special needs as a peer mentor
   c. share laboratory resources (machines, tools and instructor's individual attention)
4. ***Self-Management:*** *Assesses self accurately, sets personal goals, monitors progress, and exhibits self-control*
   a. perform in-process quality checks on machined parts
   b. maintain a record of academic achievement (individual grade book)
   c. make accommodations to laboratory schedules due to broken machines/tools
   d. accept the responsibility for self-management
5. ***Integrity/Honesty:*** *Chooses ethical courses of action*
   a. accept the responsibility for own actions
   b. exhibit personal honesty at all times
   c. accept the challenge of doing your own work in the laboratory, during examination, and on outside assignments
   d. understand the consequences of unethical behaviors

Appropriate Reference Materials:

1. Machinery's Handbook, Industrial Press
2. Applied Statics and Strength of Materials, Spiegel and Limbunner, Merrill Publishers

MET312
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***M**achine Tool **A**dvanced **S**kills*
***T**echnology Program*

MAST

COURSE SYLLABUS

CAD/CAM II

Prerequisite: CAD/CAM I

MAST PROGRAM
COURSE SYLLABUS
CAD/CAM II

Lecture hours/week: 3 **Lab hours/week: 3** **Credit hours: 4**

COURSE DESCRIPTION:

A continuation of CAD/CAM I with advanced utilization of "SMARTCAM". Topics will include the following: 3-D Process Modeling, creation and utilization of different work planes, 4th and 5th axis programming, creation of tool path for surface primitives, swept surfaces, translated surfaces, sculpted surfaces, ruled surfaces, and coons surfaces. Additional topics include: projecting, intersecting, blending, and trimming one surface to another surface. Students will program both a simple punch and die set and a simple injection mold cavity.

PREREQUISITES: **CAD/CAM I**

REQUIRED COURSE MATERIALS:

Textbook: SMARTCAM-3D, Pelton, TSTC Pub., 2nd Ed.
Lab Manual: **NONE**

Materials and/or Supplies: 2 - double sided, high density 3 ½" floppy diskettes

METHODS OF INSTRUCTION:

Lecture: Didactic presentations will include lecture, overheads and SMARTCAM and software demonstrations.

Laboratory: Laboratory will be a "hands-on" (computer based) process modeling "SMARTCAM" System.

Method of Evaluation: A student's grade will be based on multiple measures of performance. The assessment will measure development of independent critical thinking skills and will include evaluation of the student's ability to:

1. demonstrate the comprehension of Work Plane and Plane Coordinates and the ability to change from one work plane to another work plane to perform work
2. demonstrate the ability to construct surface boundaries on various work planes
3. demonstrate the ability to both identify and create various surfaces which are available in the SMARTCAM 3-D system to include:
   Surface Primitives: Plane, Cone, Cylinder, Sphere, Toris
   Composite Surfaces: Spun, Translated, Ruled, Lofted, Form Patch, Coons
4. generate tool path in both the generator, radial and planar directions
5. develop tool path geometry and part geometry to produce accurately coded information for 3-D CNC mill parts

6. demonstrate the 3-D techniques of projection, intersection, surface trim and blend
7. utilize plotters and printers to produce accurate documents
8. perform and demonstrate the ability to transfer CAD files to CAM files and CAM files to CAD files
9. generate a tool path from CAD to CAM files
10. edit a tool path from a CAD file and proof the tool path from a CAD file
11. satisfactorily perform on written, oral, and practical examinations
12. satisfactorily perform on outside assignments including writing assignments
13. contribute to class discussions
14. maintain attendance per current policy

LECTURE OUTLINE:

	Lecture Topics	Text Reference Page	Contact Hrs.
Unit 1	**Understanding 3-D Parts**	**1-9**	
1.01	Coordinate Systems in SMARTCAM's Advanced 3-D Machining	1	
1.02	Choosing Active Work Planes	4	
1.03	World vs. Local Coordinate Inputs	4	
1.04	Working with Geometry on Work Planes	6	
1.05	Planning and Creating the 3-D Model	7	
Unit 2	**Surface Primitives**	**9-11**	
2.01	Understanding Surfaces	9	
2.02	Types of Surfaces	10-11	
2.02.1	Plane	10-11	
2.02.2	Cone	10-11	
2.02.3	Cylinder	10-11	
2.02.4	Sphere	10-11	
2.02.5	Toris	10-11	
Unit 3	**Composite Surfaces**	**12**	
3.01	Spun Surfaces	12	
3.02	Translated Surfaces	12	
3.03	Ruled Surfaces	12	
	Review for Quiz 1		
	QUIZ 1		
Unit 4	**Sculpted Surfaces**	**13-14**	
4.01	Lofted Surfaces	13	
4.02	Form Patch Surfaces	13-14	
4.03	Coons Surfaces	14	
Unit 5	**Modeling 3-D Surface Toolpaths**		
5.01	Expert Tips for Model Construction		
5.02	Using Wireframe Geometry for Surface E Definition		
5.03	Creating 3-D Surface Tool Paths		

5.04	Creating a Blend Surface	
5.05	Planar Cuts	
	Review for Quiz 2	
	QUIZ 2	
Unit 6	**Additional Modeling Practices**	
6.01	Projection	
6.02	Intersection	
6.03	Surface Trim and Blend	
6.04	Editing Surfaces	
	Review for Quiz 3	
	QUIZ 3	
	Total Lecture Hours	**36**

LAB OUTLINE:

	Lab Topics	Contact Hrs.
Understanding Work Planes		2
Surface Primitives		3
Composites Surfaces		2
Sculpted Surfaces		2
Process Modeling (Drawing)		24
a.	Wax Block	
b.	Pyramid	
c.	Palace	
d.	Round Punch	
e.	Ruled Block	
f.	Cross	
g.	Round Die	
h.	Shift Boot	
i.	Fin	
j.	Knobmold	
Final Project		3
	Total Lab Hours	**36**

COURSE OBJECTIVES: TECHNICAL COMPETENCIES

After the successful completion of this course the student will be able to:

A. APPLY MATHEMATICAL CONCEPTS

1. Perform Basic Arithmetic Functions
   a. Add, subtract, multiply and divide whole numbers
   b. Add, subtract, multiply, and divide fractions
   c. Add, subtract, multiply, and divide decimals
2. Interconvert Fractions/Decimals
   a. Convert fractions to decimal equivalents
   b. Convert decimal values to nearest fractional equivalent
   c. Use Decimal Equivalent Chart for conversions
3. Interconvert Metric/English measurements

a. Convert English dimensions to Metric
b. Convert Metric dimensions to English
c. Use Metric/English conversion chart

4. Utilize Trigonometric Functions
   a. Solve for unknown angles
   b. Solve for unknown sides
5. Calculate Speeds and Feeds for Machining Using SMARTCAM's Job Plan Module
   a. Calculate RPM for various metals and various tools
   b. Calculate feed for various metals, tools, and depths of cut
6. Locate Machining Points from a Datum Point
   a. Identify points using the Cartesian coordinate system
   b. Identify points using the absolute dimensioning system
   c. Identify points using the incremental dimensioning system
   d. Identify points using both world and local coordinate values

B. INTERPRET ENGINEERING DRAWINGS AND CONTROL DOCUMENTS

1. Review Blueprint Notes and Dimensions
   a. Explain basic blueprint terminology
   b. Identify the types of dimensions
   c. Identify general note symbols
   d. Locate notes on a print
   e. Interpret commonly used abbreviations and terminology
   f. Determine tolerances associated with dimensions on a drawing
   g. Determine the tolerance for a reference dimension
   h. Determine the surface finish for a given part
   i. List the essential components found in the general drawing notes
2. Identify Basic Layout of Drawings
   a. Identify types of lines within a drawing
   b. Identify item number symbols
   c. Identify general note symbols
   d. List the essential components found in the title block
   e. Locate bill of materials in a drawing
   f. Identify the components found in the revision block
3. Identify Basic Types of Drawings
   a. Identify orthographic views
   b. Identify positions of views (top, front, side, and auxiliary)
   c. Visualize one or more views from a given view
   d. Identify isometric views
   e. Identify exploded isometric drawings
   f. Identify assembly drawings
4. Verify Drawing Elements
   a. Determine the scale of the view or section
   b. Check for revisions
   c. Recognize out-of-date blueprints
5. Practice Geometric Dimensioning and Tolerancing (GD&T) Methodology
   a. Identify the purpose of GD&T
   b. Identify symbols for controlling location (or true position) of part features
   c. Identify symbols for controlling form (or alignment) of part features
   d. Identify symbols for showing datums and basic dimensions on drawings

e. Identify symbols for Maximum Material Size (MMS) and Regardless of Feature Size (RFS)

6. Describe the Relationship of Engineering Drawings to Planning
   a. Discuss production schedule
   b. Discuss Material Resource Planning (MRP)
   c. Discuss inventory control records
   d. Utilize "SMARTCAM's" Job Plan to determine machine operations sequences
7. Analyze Bill of Materials (BOM)
   a. Discuss components found on BOM
   b. Determine materials needed to produce the part
   c. Determine quantities necessary to produce the part
   d. Submit completed stock request form as required
   e. Submit completed tool request form as needed

C. RECOGNIZE DIFFERENT MANUFACTURING MATERIALS AND PROCESSES

1. Determine Operations to be performed
   a. Identify workpiece material requirements
   b. Identify cutting tool material requirements speeds, feeds, depth of cuts
   c. Identify setup parameters, strength and ridigity of setup, strength and ridigity of the workpiece, power requirements, finish and tolerances, use of coolants
2. Sequence Machine Operations
   a. Utilize "SMARTCAM's" 3-D Modeling Tool
   b. Verify toolpath

COURSE OBJECTIVES: SCANS COMPETENCIES

The Secretary's Commission on Achieving Necessary Skills (SCANS), U.S. Department of Labor, has identified in its "AMERICA 2000 REPORT" that all students should develop a new set of competencies and foundation skills if they are to enjoy a productive, full and satisfying life. These are in addition to the Technical Workplace Competencies required by industry. SCANS is made up of five competencies and a three-part foundation of skills and personal qualities that are needed for solid job performance.

The following activities will be performed by each student for successful completion of this course:

I. COMPETENCIES

A. Resources: Identifies, organizes, plans, and allocates resources
   1. follows a schedule to complete assigned tasks on time
   2. provide a self-evaluation of performance based on the time and quality of work

B. Interpersonal: Works with others
   1. complete assigned responsibilities within the laboratory serving as a member of the team

2. provide individual assistance/direction to peers as requested
3. works well with all members of the class

C. *Information: Acquires and uses information*
1. read and interpret blueprints
2. organize and apply theories of machine tool operation

D. *Systems: Understands complex inter-relationships*
1. demonstrate knowledge of the following systems:
   a. laboratory organization structure: physical and social
   b. systematic approach to the metal removal process
   c. dimensioning and measurement systems
   d. systematic organization of training materials
2. monitors and corrects performance during
   a. the machining process
   b. adjustments of individual laboratory work schedule
   c. constantly evaluating the quality of work to achieve acceptable standards
   d. maintains record of evaluations and sets individual goals

E. *Technology: Works with a variety of technologies*
1. chooses procedure, tools and equipment required to produce a part
2. applies appropriate procedures and uses appropriate tools and equipment to produce a machined part to acceptable standards

II. FOUNDATION SKILLS

A. ***Basic Skills:*** *Reads, writes, performs arithmetic and mathematical operations, listens and speaks.*
1. ***Reading:*** *Locates, understands, and interprets written information in prose and in documents such as manuals, graphs, and schedules*
   a. studies student laboratory manual
   b. interprets blueprints and technical drawings
   c. read/studies textbook
   d. follow a daily laboratory schedule to maintain appropriate time-line and product completion
2. ***Writing:*** *Communicates thoughts, ideas, information, and messages in writing; and creates documents such as letters, directions, manuals, reports, graphs, and flow charts*
   a. outline the steps necessary to produce a simple machine part
   b. maintain a lecture notebook
   c. submit written responses to chapter question assignments
   d. complete all written assignments
3. ***Arithmetic/Mathematics:*** *Perform basic computations and approaches practical problems by choosing appropriately from a variety of mathematical techniques*
   a. determines optimum machining speeds, feeds, and depth of cut
   b. calculates "value added to the part"
4. ***Listening:*** *Receives, attends to, interprets, and responds to verbal messages and other cues*
   a. assimilate classroom instruction
   b. interpret and assimilate video instruction

c. observe laboratory demonstrations
d. seek and receive individualized instruction in the laboratory

5. ***Speaking:*** *Organizes ideas and communicates orally*
   a. participates in classroom discussions
   b. organize ideas and communicate specific questions to the instructor
   c. verbally affirms understanding of a concept, procedure, or required skill
   d. communicates with peers to ensure the smooth and safe operation of the laboratory

B. ***Thinking Skills:*** *Thinks creatively, makes decisions, solves problems, visualizes, knows how to learn and reasons.*

1. ***Decision Making:*** *Specifies goals and constraints, generates alternatives, considers risks, and evaluates and chooses best alternative*
   a. identifies personal goals
   b. identifies actions required to accomplish personal goals

2. ***Problem Solving:*** *Recognizes problems and devises and implements plan of action*
   a. makes daily accommodations to stay on schedule
   b. seeks additional instruction/clarification for assignment completion
   c. balances social and academic life/responsibilities
   d. accepts responsibility

3. ***Seeing Things In the Mind's Eye:*** *Organizes, and processes symbols, pictures, graphs, objects, and other information*
   a. interprets technical drawings
   b. interprets technical illustrations and symbols
   c. understands both written and verbal instructions
   d. assimilates process during instructor demonstrations

4. ***Knowing How to Learn:*** *Use efficient learning techniques to acquire and apply new knowledge and skills*
   a. demonstrate mastery of the basic skills and techniques
   b. use these sequential skills to support mastery of new skills
   c. understand the sequential nature of acquired skills and the subsequent knowledge application of new skills and techniques

5. ***Reasoning:*** *Discovers a rule or principle underlying the relationship between two or more objects and applies it when solving a problem*
   a. understands that practice may not make it perfect but it certainly will improve the skill of the technician
   b. understands the relationship between different metals and the tool applied to the metal surface and adjusts machining parameters accordingly

C. ***Personal Qualities:*** *Displays responsibility, self-esteem, sociability, self-management, and integrity and honesty.*

1. ***Responsibility:*** *Exerts a high level of effort and perseveres towards goal attainment*
   a. develops an understanding that in order to be successful you must be a "good" student
   b. develops an understanding that a "good" student is the one who is prompt to every class and has prepared for the day's work

c. develops an understanding good students know what they are going to do in class and does not waste time
d. develops a fine work-ethic

2. ***Self-Esteem:*** *Believes in own self-worth and maintains a positive view of self*
   a. learns to take pride in his or her work through positive reinforcement
   b. sees himself or herself as an asset to the class through continued contributions to the group and a shared common goal
   c. understands that an individual with a positive attitude and the belief in their own abilities will systematically seek solutions and be a valuable employee

3. ***Sociability:*** *Demonstrates understanding, friendliness, adaptability, empathy, and politeness in group settings*
   a. assist classmates in improving technical skills
   b. assist students with special needs as a peer mentor
   c. share laboratory resources (machines, tools and instructor's individual attention)

4. ***Self-Management:*** *Assesses self accurately, sets personal goals, monitors progress, and exhibits self-control*
   a. perform in-process quality checks on machined parts
   b. maintain a record of academic achievement (individual gradebook)
   c. make accommodations to laboratory schedules due to broken machines/tools
   d. accept the responsibility for self-management

5. ***Integrity/Honesty:*** *Chooses ethical courses of action*
   a. accept the responsibility for own actions
   b. exhibit personal honesty at all times
   c. accept the challenge of doing your own work in the laboratory, during examination, and on outside assignments
   d. understand the consequences of unethical behaviors

Appropriate Reference Materials:

1. SMARTCAM Advanced 3-D Machining Reference Manual
2. Technology of Machine Tools, 4th Ed. McGraw Hill Publishers
3. Machine Tool Catalogs

*M*achine Tool *A*dvanced *S*kills
*T*echnology Program

MAST

COURSE SYLLABUS

COMPUTER INTEGRATED MANUFACTURING

MAST PROGRAM
COURSE SYLLABUS
COMPUTER INTEGRATED MANUFACTURING

Lecture hours/week: 2 **Lab hours/week: 2** **Credit hours: 3**

COURSE DESCRIPTION:

An introduction to fundamentals of Computer Integrated Manufacturing (CIM). This include the key elements and technologies involved, the typical applications that exist in industry today and the major trends that will affect the future of manufacturing.

PREREQUISITES: **NONE**

REQUIRED COURSE MATERIALS:

Textbook: Computer-Automated Manufacturing, John H. Powers Jr., McGraw-Hill Publishers, 1987

Lab Manual: **NONE**

Hand Tools/Quantity Required:

Safety Glasses
6 inch Ruler
0-6 inch Dial Calipers
Pencil
Scientific Calculator
3½ high density disk

METHODS OF INSTRUCTION:

Lecture: Didactic presentations will include lecture, video and demonstrations.

Laboratory: Laboratory will be "hands-on" activities.

Method of Evaluation: A student's grade will be based on multiple measures of performance. The assessment will measure development of independent critical thinking skills and will include evaluation of the student's ability to:

1. perform the manipulative skills of the craft as required to satisfactorily complete laboratory assignments
2. apply theory to laboratory assignments
3. satisfactorily perform on written, oral, and practical examinations
4. satisfactorily perform on outside assignments including writing assignments
5. contribute to class discussions
6. maintain attendance per current policy
7. follow all shop rules and safety regulations as stated in the laboratory manual

LECTURE OUTLINE:

Lecture Topics	Text Reference Page	Contact Hrs.
Introduction to Computer-Automated Manufacturing		4
What is Computer-Automated Manufacturing	2	
Why Do We Use Computers in Manufacturing	10	
Computer Control	18	
Computer Applications in Manufacturing	28	
Trends in the Use of Computers in Manufacturing	38	
Computer Technologies		4
Computer Hardware	48	
Computer Software	63	
Micro and Minicomputers	77	
Artificial Intelligence	92	
Computer Automated Engineering		4
Computer Graphics Technology	112	
Computer Automated Design	132	
Computer Tools for Engineering Analysis	148	
Robotics		4
Basic Robotic Technology	164	
Intelligent Robotics Systems	176	
Robot Application	195	
Implementing Robotics in Manufacturing	207	
Manufacturing Systems		4
System Architecture	218	
Management Systems	234	
Integrated Manufacturing Systems	254	
Computer Automated Manufacturing		4
Automated Manufacturing	274	
Implementing CAM	290	
	Total Lecture Hours	**24**

LAB OUTLINE:

Lab Topics	Contact Hrs.
CIM Lab Safety	2
CIM System Components	6
a) Conveyor Systems	
b) Automated Storage and Retrieval Systems	
c) PUMA 562 Robot	
d) IBM 7576 Robot	
e) CNC Vertical Milling Center	
f) CNC Turning Center	
g) Vision Systems	

h) Barcode Systems	
CIM Software	4
Robot Programming	4
Programming CNC Machining Centers	4
Manufacturing Cells/System Integration	4
Total Lab Hours	**24**

COURSE OBJECTIVES: TECHNICAL COMPETENCIES

After the successful completion of this course the student will be able to:

A. PRACTICE SAFETY

1. Follow Safety Manuals and All Safety Regulations/Requirements
   a. Assume responsibility for the personal safety of oneself and others
   b. Develop a personal attitude towards safety
   c. Interpret safety manual directives
   d. Comply with established company safety practices
   e. Complete forms/paperwork as required
2. Use Protective Equipment
   a. Wear protective safety clothing as required
   b. Maintain and use protective guards and equipment on machinery
   c. Locate and properly use protective equipment
   d. Use lifting aids when necessary
3. Follow Safe Operating Procedures for Hand and Machine Tools
   a. Identify and understand safe machine operating procedures
   b. Demonstrate safe machine operation
4. Maintain a Clean and Safe Work Environment
   a. Keep work areas clean
   b. Clean machine/hand tools when work is completed
   c. Put tools away when work is finished
   d. Keep aisles clear of equipment and materials
   e. Perform preventative maintenance as required
5. Apply Ergonomic Principles to the Workplace
   a. Define ergonomics
   b. Explain the characteristics and potential impact of ergonomics on design, productivity, and safety

B. INTERPRET ENGINEERING DRAWINGS AND CONTROL DOCUMENTS

1. Describe the Relationship of Engineering Drawings to Planning
   a. Discuss production schedule
   b. Discuss Material Resource Planning (MRP)
   c. Discuss inventory control records
   d. Discuss shop floor routing documents
2. Analyze Bill of Materials (BOM)
   a. Discuss components found on BOM
   b. Determine materials needed to produce the part
   c. Determine quantities necessary to produce the part
   d. Submit completed stock request form as required
   e. Submit completed tool request form as needed

3. Understand and Use Quality Systems
   a. Describe ISO 9000 quality system
   b. Document paper trails for document revisions

C. USE COMPUTERS

1. Use Computer Operating Systems
   a. Use basic computer terminology appropriately and accurately
   b. Boot the computer and recognize the basic components of DOS
   c. Use DOS to perform file management
   d. Use DOS to perform directory management
   e. Install software packages on a PC
2. Use Computer Inquiry Systems
   a. Log in to a multi-user system
   b. Access system for needed information
   c. Print reports as necessary
3. Use Various Computer Applications
   a. Load word processor, create, save, edit, and print a document
   b. Load spreadsheet, create, save, retrieve, erase, edit, and print a worksheet
   c. Load database programs, create, edit, delete, and print records in a database file
4. Recommend and Implement CIM Technologies
   a. Use automatic storage & retrieval system
   b. Use bar coding technology
   c. Understand robot applications
   d. Program robots
   e. Use shop floor control systems
   f. Understand machine vision systems

COURSE OBJECTIVES: SCANS COMPETENCIES

The Secretary's Commission on Achieving Necessary Skills (SCANS), U.S. Department of Labor, has identified in its "AMERICA 2000 REPORT" that all students should develop a new set of competencies and foundation skills if they are to enjoy a productive, full and satisfying life. These are in addition to the Technical Workplace Competencies required by industry. SCANS is made up of five competencies and a three-part foundation of skills and personal qualities that are needed for solid job performance.

The following activities will be performed by each student for successful completion of this course:

I. COMPETENCIES

A. Resources: *Identifies, organizes, plans, and allocates resources*

1. follows a schedule to complete assigned tasks on time
2. determine the initial cost of materials and "value added" as result of machining
3. provide a self-evaluation of performance based on the time and quality of work

B. ***Interpersonal:*** *Works with others*

1. complete assigned responsibilities within the shop floor serving as a member of the team
2. provide individual assistance/direction to peers as requested
3. works well with all members of the class

C. ***Information:*** *Acquires and uses information*

1. understand and recommend CIM related technologies

D. ***Systems:*** *Understands complex inter-relationships*

1. demonstrate knowledge of the following systems:
   a. laboratory organization structure: physical and social
   b. organization of personnel and facilities on the shop floor
   c. systematic organization of training materials
2. monitors and corrects performance during
   a. adjustments of individual laboratory work schedule
   b. constantly evaluating the quality of work to achieve acceptable standards
   c. maintains record of evaluations and sets individual goals

E. ***Technology:*** *Works with a variety of technologies*

1. chooses procedure, tools and equipment required to produce a part
2. applies appropriate procedures and uses appropriate tools and equipment to produce a machined part to acceptable standards
3. maintains and troubleshoots equipment
   a. applies appropriate preventative maintenance
   b. when operating machines
   c. reports all malfunctions of equipment to supervisor/instructor
   d. perform clean-up assignments of machine and shop floor at the end of the laboratory

II. FOUNDATION SKILLS

A. ***Basic Skills:*** *Reads, writes, performs arithmetic and mathematical operations, listens and speaks.*

1. ***Reading:*** *Locates, understands, and interprets written information in prose and in documents such as manuals, graphs, and schedules*
   a. studies student laboratory manual
   b. interprets blueprints and technical drawings
   c. read/studies textbook
   d. follow a daily laboratory schedule to maintain appropriate time-line and product completion

2. ***Writing:*** *Communicates thoughts, ideas, information, and messages in writing; and creates documents such as letters, directions, manuals, reports, graphs, and flow charts*
   a. maintain a lecture notebook
   b. submit written responses to chapter question assignments
   c. complete all written assignments

3. ***Arithmetic/Mathematics:*** *Perform basic computations and approaches practical problems by choosing appropriately from a variety of mathematical techniques*
   a. calculates "value added to the part"

b. keeps a running computation of individual grade

4. ***Listening:*** *Receives, attends to, interprets, and responds to verbal messages and other cues*
   a. assimilate classroom instruction
   b. interpret and assimilate video instruction
   c. observe laboratory demonstrations
   d. seek and receive individualized instruction in the laboratory
5. ***Speaking:*** *Organizes ideas and communicates orally*
   a. participates in classroom discussions
   b. organize ideas and communicate specific questions to the instructor
   c. verbally affirms understanding of a concept, procedure, or required skill
   d. communicates with peers to ensure the smooth and safe operation of the laboratory

B. ***Thinking Skills:*** *Thinks creatively, makes decisions, solves problems, visualizes, knows how to learn and reasons.*
1. ***Decision Making:*** *Specifies goals and constraints, generates alternatives, considers risks, and evaluates and chooses best alternative*
   a. identifies personal goals
   b. identifies actions required to accomplish personal goals
2. ***Problem Solving:*** *Recognizes problems and devises and implements plan of action*
   a. makes daily accommodations to stay on schedule
   b. seeks additional instruction/clarification for assignment completion
   c. balances social and academic life/responsibilities
   d. accepts responsibility
3. ***Seeing Things In the Mind's Eye:*** *Organizes, and processes symbols, pictures, graphs, objects, and other information*
   a. interprets technical drawings
   b. interprets technical illustrations and symbols
   c. understands both written and verbal instructions
   d. assimilates process during instructor demonstrations
4. ***Knowing How to Learn:*** *Use efficient learning techniques to acquire and apply new knowledge and skills*
   a. demonstrate mastery of the basic skills and techniques
   b. use these sequential skills to support mastery of new skills
   c. understand the sequential nature of acquired skills and the subsequent knowledge application of new skills and techniques
5. ***Reasoning:*** *Discovers a rule or principle underlying the relationship between two or more objects and applies it when solving a problem*
   a. understands that practice may not make it perfect but it certainly will improve the skill of the operator
   b. understands that the quality of the product is a function of the time of the operation and the attitude and skill of the machinist
   c. understands the relationship between different metals and the tool applied to the metal surface and adjusts machining parameters accordingly

C. ***Personal Qualities:*** *Displays responsibility, self-esteem, sociability, self-management, and integrity and honesty.*

1. ***Responsibility:*** *Exerts a high level of effort and perseveres towards goal attainment*
   a. develops an understanding that in order to be successful you must be a "good" student
   b. develops an understanding that a "good" student is the one who is prompt to every class and has prepared for the day's work
   c. develops an understanding good students know what they are going to do in class and does not waste time
   d. develops a fine work-ethic
2. ***Self-Esteem:*** *Believes in own self-worth and maintains a positive view of self*
   a. learns to take pride in his or her work through positive reinforcement
   b. sees himself or herself as an asset to the class through continued contributions to the group and a shared common goal
   c. understands that an individual with a positive attitude and the belief in their own abilities will systematically seek solutions and be a valuable employee
3. ***Sociability:*** *Demonstrates understanding, friendliness, adaptability, empathy, and politeness in group settings*
   a. assist classmates in improving technical skills
   b. assist students with special needs as a peer mentor
   c. share laboratory resources (machines, tools and instructor's individual attention)
4. ***Self-Management:*** *Assesses self accurately, sets personal goals, monitors progress, and exhibits self-control*
   a. maintain a record of academic achievement (individual grade book)
   b. make accommodations to laboratory schedules due to broken machines/tools
   c. accept the responsibility for self-management
5. ***Integrity/Honesty:*** *Chooses ethical courses of action*
   a. accept the responsibility for own actions
   b. exhibit personal honesty at all times
   c. accept the challenge of doing your own work in the laboratory, during examination, and on outside assignments
   d. understand the consequences of unethical behaviors

Appropriate Reference Materials:

1. Machinery's Handbook, Industrial Press
2. Computer-Automated Manufacturing, John H. Powers Jr., McGraw-Hill Pub., 1987

*M*achine Tool *A*dvanced *S*kills
*T*echnology Program

MAST

COURSE SYLLABUS

QUALITY ASSURANCE AND STATISTICAL PROCESS CONTROL

MAST PROGRAM
COURSE SYLLABUS
QUALITY ASSURANCE AND STATISTICAL PROCESS CONTROL

Lecture hours/week: 2 **Lab hours/week: 3** **Credit hours: 3**

COURSE DESCRIPTION:

An introduction to the concepts of applied quality control systems. Topics covered include: quality responsibility, control chart methods, sampling techniques, reliability applications and computer utilization/programs.

PREREQUISITES: **NONE**

REQUIRED COURSE MATERIALS:

Textbook: Statistical Process Control and Quality Improvement, Gerald Smith, Macmillan Pub., 2nd Ed.

Lab Manual: Quality Control Laboratory Manual, TSTC

Hand Tools/Quantity Required:

Safety Glasses
6 inch Ruler
0-6 inch Dial Calipers
Pencil
Scientific Calculator with statistical functions to solve for: means and standard deviation
3½" high density disk

METHODS OF INSTRUCTION:

Lecture: Didactic presentations will include lecture, video and demonstrations.

Laboratory: Laboratory will be "hands-on" activities.

Method of Evaluation: A student's grade will be based on multiple measures of performance. The assessment will measure development of independent critical thinking skills and will include evaluation of the student's ability to:

1. perform the manipulative skills of the craft as required to satisfactorily complete laboratory assignments
2. apply theory to laboratory assignments
3. satisfactorily perform on written, oral, and practical examinations
4. satisfactorily perform on outside assignments including writing assignments

5. contribute to class discussions
6. maintain attendance per current policy
7. follow all shop rules and safety regulations as stated in the laboratory manual

LECTURE OUTLINE:

	Lecture Topics	Text Reference Page	Contact Hrs.
Introduction to Statistical Process Control			
1.1	Prevention vs. Detection	2	
1.2	SPC Goals	4	
1.3	Basic Tools of SPC	5	
1.4	Statistical Process Control Techniques	6	
1.5	The Problem-Solving Model for an Existing Process	7	
1.6	Designed Experiments	9	
1.7	What is Quality?	10	
Striving for Quality			
2.1	Management's Dilemma	14	
2.2	Leadership by Management	15	
2.3	Deming's Way	15	
2.4	Deming's 14 Points for Management	16	
2.5	Crosby's Approach	21	
2.6	A Comparison; Deming vs. Crosby	26	
2.7	Which Way to Top Quality?	26	
2.8	Avoid the Pitfalls in thee Quest for Quality	27	
2.9	Total Quality Management	29	
Introduction to Variation an Statistics			
3.1	Measurement Concepts	37	
3.2	Special-Cause and Common-Cause Variation	40	
3.3	The Variation Concepts	41	
3.4	Distributions and SPC Goals	43	
3.5	Basic Algebraic Concepts	44	
3.6	Basic Statistical Concepts	50	
Introduction to The Control Chart Concept			
4.1	Variables and Attributes	65	
4.2	Preparation for Control Charting	67	
4.3	The General Procedure for an X-Bar and R Chart	70	
The Normal Probability Distribution			
5.1	The Frequency Distribution	85	
5.2	Histograms	89	
5.3	Probability Distribution	97	

5.4 The Normal Distribution 100
Variable Control Charts
6.1 X-bar and R Charts 122
6.2 The Capability Analysis 137
6.3 The Median and Range Charts 157
6.4 X-Bar and S Charts 173
Variables Charts for Limited Data
7.1 Precontrol or Rainbow Charts 200
7.2 Compound Probability 204
7.3 Modified Precontrol for Tight Control 207
7.4 Charts for Individual Measurements 213
7.5 The Modified X-Bar and R Chart for Small Sets of Data 229
7.6 The Nominal X-Bar and R Chart 233
7.7 The Transformation X-Bar and R Chart 237
Attributes Control Charts
8.1 The Four Types of Attributes Charts 252
8.2 The P Chart 253
8.3 The NP Chart 265
8.4 The C Chart 269
8.5 The U Chart 273
8.6 SPC Applied to the Learning Process 275
Interpreting Control Chart
9.1 The Random Distribution of Points 286
9.2 Freaks 288
9.3 Binomial Distribution Applications 292
9.4 Freak Patterns 296
9.5 Shifts 302
9.6 Runs and Trends 308
9.7 Cycles 312
9.8 Grouping 313
Problem Solving
10.1 The Problem-solving Sequence 333
10.2 Teamwork and Tools for Problem Solving 335
10.3 Brainstorming 336
10.4 Flowcharts 339
10.5 Story Boards 342
10.6 The Cause-and Effect Diagram 343
10.7 Pareto Charts 347
10.8 Other Graphs for Problem Solving 354
Acceptance Sampling
11.1 The Sampling Dilemma 420

11.2	Random Sampling	427		
11.3	Operating Characteristic Curve	428		
11.4	The Average Outgoing Quality Curve	441		
11.5	MLT_STD_105D for Inspection by Attributes	444		
11.6	The Average Proportion Defective	457		
11.7	Vendor Certification and Control Chart Monitoring	462		
			Total Lecture Hours	**24**

LAB OUTLINE:

Lab Topics	Contact Hrs.
Introduction to SPC	3
Variations, Statistics and Histograms	3
Introduction to Control Charts	3
Probability Distribution	3
Variables Control Charts	3
Precontrol Charts	3
Attribute Control Charts	3
Interpreting Control Charts	3
Problem Solving	3
Acceptance Sampling	3
Total Lab Hours	**36**

COURSE OBJECTIVES: TECHNICAL COMPETENCIES

After the successful completion of this course the student will be able to:

A. PRACTICE SAFETY

1. Follow Safety Manuals and All Safety Regulations/Requirements
   a. Assume responsibility for the personal safety of oneself and others
   b. Develop a personal attitude towards safety
   c. Interpret safety manual directives
   d. Comply with established company safety practices
2. Use Protective Equipment
   a. Wear protective safety clothing as required
   b. Maintain and use protective guards and equipment on machinery
   c. Locate and properly use protective equipment
   d. Use lifting aids when necessary
3. Follow Safe Operating Procedures for Hand and Machine Tools
   a. Identify and understand safe machine operating procedures
   b. Demonstrate safe machine operation
4. Maintain a Clean and Safe Work Environment
   a. Keep work areas clean
   b. Clean machine/hand tools when work is completed

c. Put tools away when work is finished
d. Keep aisles clear of equipment and materials

B. APPLY MATHEMATICAL CONCEPTS

1. Perform Basic Arithmetic Functions
   a. Add, subtract, multiply and divide whole numbers
   b. Add, subtract, multiply, and divide fractions
   c. Add, subtract, multiply, and divide decimals
2. Interconvert Fractions/Decimals
   a. Convert fractions to decimal equivalents
   b. Convert decimal values to nearest fractional equivalent
   c. Use Decimal Equivalent Chart for conversions
3. Interconvert Metric/English Measurements
   a. Convert English dimensions to Metric
   b. Convert Metric dimensions to English
   c. Use Metric/English conversion chart
4. Perform Basic Algebraic Operations
   a. Express word statements as algebraic equations
   b. Solve word statements ass algebraic equations
5. Perform Basic Trigonometric Functions
   a. Solve for unknown angles
   b. Solve for unknown sides
6. Use all Functions on a Scientific Calculator
   a. Apply all trigonometric functions
   b. Apply all algebraic functions
   c. Apply all statistical functions

C. INTERPRET ENGINEERING DRAWINGS AND CONTROL DOCUMENTS

1. Review Blueprint Notes and Dimensions
   a. Explain basic blueprint terminology
   b. Identify the types of dimensions
   c. Identify general note symbols
   d. Locate notes on a print
   e. Interpret commonly used abbreviations and terminology
   f. Determine tolerances associated with dimensions on a drawing
   g. Determine the tolerance for a reference dimension
   h. Determine the surface finish for a given part
   i. List the essential components found in the general drawing notes
2. Identify Basic Layout of Drawings
   a. Identify types of lines within a drawing
   b. Identify item number symbols
   c. Identify general note symbols
   d. List the essential components found in the title block
   e. Locate bill of materials in a drawing
   f. List the components found in the revision block
3. Identify Basic Types of Drawings
   a. Identify orthographic views
   b. Identify positions of views (top, front, side, and auxiliary)
   c. Visualize one or more views from a given view

d. Identify isometric views
e. Identify exploded isometric drawings
f. Identify assembly drawings

4. Verify Drawing Elements
   a. Determine the scale of the view or section
   b. Check for revisions
   c. Recognize out-of-date blueprints
5. Practice Geometric Dimensioning and Tolerancing (GD&T) Methodology
   a. Identify the purpose of GD&T
   b. Identify symbols for controlling location (or true position) of part features
   c. Identify symbols for controlling form (or alignment) of part features
   d. Identify symbols for showing datums and basic dimensions on drawings
   e. Identify symbols for Maximum Material Size (MMS) and Regardless of Feature Size (RFS)
6. Describe the Relationship of Engineering Drawings to Planning
   a. Discuss production schedule
   b. Discuss Material Resource Planning (MRP)
   c. Discuss inventory control records
7. Use Standards to Verify Requirements
   a. Discuss the purpose of standards
   b. Discuss source locations for standards
8. Analyze Bill of Materials (BOM)
   a. Discuss components found on BOM
   b. Determine materials needed to produce the part
   c. Determine quantities necessary to produce the part
   d. Submit completed stock request form as required
   e. Submit completed tool request form as needed

D. RECOGNIZE DIFFERENT MANUFACTURING MATERIALS AND PROCESSES

1. Identify Materials With Desired Properties
   a. Discuss classification system for metals
   b. Discuss classification systems for non-metals

E. PERFORM MEASUREMENT/INSPECTION

1. Identify Types of Measurement Used in the Machine Shop
   a. Distinguish between direct and calculated measurements
   b. Compute calculated measurements
   c. Justify the use of precision measurements in manufacturing
   d. Discuss the following: precision, reliability , and accuracy
   e. Demonstrate general measurement techniques
   f. Demonstrate semi-precision measurement techniques
   g. Demonstrate precision measurement techniques
   h. Document results of measurement activities and calculations
2. Select Proper Measurement Tools
   a. Match appropriate measurement tools with various types of measurement requirements
   b. Demonstrate proper measurement tool usage
   c. List steps of proper measurement

d. Explain rationale for each step
e. Identify error possibilities in measurement tool selection
f. Identify error possibilities within measurement procedures
g. Identify common conversion error possibilities
h. Discriminate between accepted measurement procedures and improper measurement procedures

3. Apply Proper Measuring Techniques
   a. Explain calibration requirements of various precision instruments
   b. Illustrate measurement differences when taken with calibrated and non-calibrated instruments
   c. Justify use of particular measurement tools based on tool characteristics
   d. Discuss factors affecting accurate measurement (dirt, temperature, etc.)
4. Perform Measurements With Hand Held Instruments
   a. Measure with steel rules (metric and inch)
   b. Measure with micrometers
   c. Measure with comparison measuring instruments (i.e., calipers, telescope gages)
   d. Measure with direct measuring instruments (i.e., vernier, dial, and digital instruments)
   e. Measure with fixed gages (go and not go gages)
5. Perform Measurements on Surface Plate
   a. Describe care of surface plate
   b. Use surface plate accessories correctly (sine bar, gage blocks, etc.)
   c. Check for part squareness
   d. Check part dimensions for accuracy
   e. Align workpieces using height gage and dial indicators

F. USE COMPUTERS

1. Use Computer Operating Systems
   a. Use basic computer terminology appropriately and accurately
   b. Boot the computer and recognize the basic components of DOS
   c. Use DOS to perform file management
   d. Use DOS to perform directory management
   e. Install software packages on a PC
2. Use Computer Inquiry Systems
   a. Login to a multi-user system
   b. Access system for needed information
   c. Print reports as necessary
3. Use Various Computer Applications
   a. Load word processor, create, save, edit and print a document
   b. Load spreadsheet, create, save, retrieve, erase, edit and print a worksheet
   c. Load database programs, create, edit, delete, and print records in a database file

G. PARTICIPATE IN TOTAL QUALITY AND SPC ACTIVITIES

1. Define Quality in Manufacturing and Explain Importance
   a. Justify the use of quality in manufacturing systems
   b. Identify impact of quality on specific manufacturing processes
2. Implement Concepts of Quality in the Workplace

a. Explain how profit is generated
b. Explain how manufacturing costs are determined
c. Explain the effect of quality in profit
d. Explain the cost incurred by scrapping parts or correcting parts with defects

3. Apply Principles and Tools of Continuous Quality Improvement
   a. Identify the effect of continuous quality improvement
   b. Demonstrate the ability to apply continuous quality improvement to the manufacturing process
4. Understand and Apply SPC
   a. Define SPC
   b. Identify the relationship between SPC steps and specific production
   c. Apply SPC to specific production processes
   d. Recognize a standard deviation
5. Evaluate Data to Monitor Production
   a. Understand process variation
   b. Understand probability
   c. Create a Histogram
   d. Set up and use X-bar, R Charts
   e. Calculate process capability index
   f. Calculate gauge capability
6. Analyze Customer Problems and Recommend Solutions
   a. Analyze production specific processes
   b. Analyze and interpret test data for compliance to specifications
   c. Correct production process(if indicated by data)
   d. Maintain production according to instructions
7. Establish Methods, Plans and Procedures to Maintain Quality
   a. Develop a plan utilizing a selected quality control system
   b. Evaluate a process selected verse desired goals

COURSE OBJECTIVES: SCANS COMPETENCIES

The Secretary's Commission on Achieving Necessary Skills (SCANS), U.S. Department of Labor, has identified in its "AMERICA 2000 REPORT" that all students should develop a new set of competencies and foundation skills if they are to enjoy a productive, full and satisfying life. These are in addition to the Technical Workplace Competencies required by industry. SCANS is made up of five competencies and a three-part foundation of skills and personal qualities that are needed for solid job performance.

The following activities will be performed by each student for successful completion of this course:

I. COMPETENCIES

A. ***Resources:*** *Identifies, organizes, plans, and allocates resources*

1. follows a schedule to complete assigned tasks on time
2. determine the initial cost of materials and "value added" as result of machining
3. provide a self-evaluation of performance based on the time and quality of work

B. Interpersonal: Works with others

1. complete assigned responsibilities within the shop floor serving as a member of the team
2. provide individual assistance/direction to peers as requested
3. works well with all members of the class

C. Information: Acquires and uses information

1. read and interpret blueprints
2. organize and apply theories of machine tool operation

D. Systems: Understands complex inter-relationships

1. demonstrate knowledge of the following systems:
   a. laboratory organization structure: physical and social
   b. organization of personnel and facilities on the shop floor
   c. systematic approach to the metal removal process
   d. dimensioning and measurement systems
   e. systematic organization of training materials
2. monitors and corrects performance during
   a. adjustments of individual laboratory work schedule
   b. constantly evaluating the quality of work to achieve acceptable standards
   c. maintains record of evaluations and sets individual goals

E. Technology: Works with a variety of technologies

1. chooses procedure, tools and equipment required to produce a part
2. applies appropriate procedures and uses appropriate tools and equipment to produce a machined part to acceptable standards
3. maintains and troubleshoots equipment
   a. applies appropriate preventative maintenance
   b. when operating machines
   c. reports all malfunctions of equipment to supervisor/instructor
   d. perform clean-up assignments of machine and shop floor at the end of the laboratory

II. FOUNDATION SKILLS

A. Basic Skills: Reads, writes, performs arithmetic and mathematical operations, listens and speaks.

1. Reading: Locates, understands, and interprets written information in prose and in documents such as manuals, graphs, and schedules

a. studies student laboratory manual
b. interprets blueprints and technical drawings
c. read/studies textbook
d. follow a daily laboratory schedule to maintain appropriate time-line and product completion

2. ***Writing:*** *Communicates thoughts, ideas, information, and messages in writing; and creates documents such as letters, directions, manuals, reports, graphs, and flow charts*
   a. outline the steps necessary to produce a simple machine part
   b. maintain a lecture notebook
   c. submit written responses to chapter question assignments
   d. complete all written assignments
3. ***Arithmetic/Mathematics:*** *Perform basic computations and approaches practical problems by choosing appropriately from a variety of mathematical techniques*
   a. determines optimum machining speeds, feeds, and depth of cut
   b. calculates "value added to the part"
   c. aligns machine and/or work holding device
   d. keeps a running computation of individual grade
   e. interconverts fractions to decimal expressions
4. ***Listening:*** *Receives, attends to, interprets, and responds to verbal messages and other cues*
   a. assimilate classroom instruction
   b. interpret and assimilate video instruction
   c. observe laboratory demonstrations
   d. seek and receive individualized instruction in the laboratory
5. ***Speaking:*** *Organizes ideas and communicates orally*
   a. participates in classroom discussions
   b. organize ideas and communicate specific questions to the instructor
   c. verbally affirms understanding of a concept, procedure, or required skill
   d. communicates with peers to ensure the smooth and safe operation of the laboratory

B. ***Thinking Skills:*** *Thinks creatively, makes decisions, solves problems, visualizes, knows how to learn and reasons.*
1. ***Decision Making:*** *Specifies goals and constraints, generates alternatives, considers risks, and evaluates and chooses best alternative*
   a. identifies personal goals
   b. identifies actions required to accomplish personal goals
2. ***Problem Solving:*** *Recognizes problems and devises and implements plan of action*
   a. makes daily accommodations to stay on schedule
   b. seeks additional instruction/clarification for assignment completion
   c. balances social and academic life/responsibilities
   d. accepts responsibility
3. ***Seeing Things In the Mind's Eye:*** *Organizes, and processes symbols, pictures, graphs, objects, and other information*
   a. interprets technical drawings
   b. interprets technical illustrations and symbols
   c. understands both written and verbal instructions
   d. assimilates process during instructor demonstrations

4. ***Knowing How to Learn:*** *Use efficient learning techniques to acquire and apply new knowledge and skills*
    a. demonstrate mastery of the basic skills and techniques
    b. use these sequential skills to support mastery of new skills
    c. understand the sequential nature of acquired skills and the subsequent knowledge application of new skills and techniques
5. ***Reasoning:*** *Discovers a rule or principle underlying the relationship between two or more objects and applies it when solving a problem*
    a. understands that practice may not make it perfect but it certainly will improve the skill of the operator
    b. understands that the quality of the product is a function of the time of the operation and the attitude and skill of the machinist
    c. understands the relationship between different metals and the tool applied to the metal surface and adjusts machining parameters accordingly

C. ***Personal Qualities:*** *Displays responsibility, self-esteem, sociability, self-management, and integrity and honesty.*
1. ***Responsibility:*** *Exerts a high level of effort and perseveres towards goal attainment*
    a. develops an understanding that in order to be successful you must be a "good" student
    b. develops an understanding that a "good" student is the one who is prompt to every class and has prepared for the day's work
    c. develops an understanding good students know what they are going to do in class and does not waste time
    d. develops a fine work-ethic
2. ***Self-Esteem:*** *Believes in own self-worth and maintains a positive view of self*
    a. learns to take pride in his or her work through positive reinforcement
    b. sees himself or herself as an asset to the class through continued contributions to the group and a shared common goal
    c. understands that an individual with a positive attitude and the belief in their own abilities will systematically seek solutions and be a valuable employee
3. ***Sociability:*** *Demonstrates understanding, friendliness, adaptability, empathy, and politeness in group settings*
    a. assist classmates in improving technical skills
    b. assist students with special needs as a peer mentor
    c. share laboratory resources (machines, tools and instructor's individual attention)
4. ***Self-Management:*** *Assesses self accurately, sets personal goals, monitors progress, and exhibits self-control*
    a. perform in-process quality checks on machined parts
    b. maintain a record of academic achievement (individual gradebook)
    c. make accommodations to laboratory schedules due to broken machines/tools

d. accept the responsibility for self-management

5. ***Integrity/Honesty:*** *Chooses ethical courses of action*
   a. accept the responsibility for own actions
   b. exhibit personal honesty at all times
   c. accept the challenge of doing your own work in the laboratory, during examination, and on outside assignments
   d. understand the consequences of unethical behaviors

Appropriate Reference Materials:

1. Machinery's Handbook, Industrial Press
2. Statistical Process Control and Quality Improvement, by Gerald Smith, Macmillan Publishing Company, 1991

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*M*achine Tool *A*dvanced *S*kills
*T*echnology Program

MAST

COURSE SYLLABUS

ENGINEERING TECHNOLOGY PROJECT

MAST PROGRAM
COURSE SYLLABUS
ENGINEERING TECHNOLOGY PROJECT

Lecture hours/week: 4 **Lab hours/week: 6** **Credit hours: 6**

COURSE DESCRIPTION:

Different industrial level projects emphasizing manufacturing applications/research in the areas of *CNC*, CAD/CAM, CIM, or Plastic *Mold Making* will be assigned to students utilizing a team concept.

PREREQUISITES: **NONE**

REQUIRED COURSE MATERIALS:

Textbook: **NONE**
Lab Manual: **NONE**

Hand Tools/Quantity Required: See basic tool list for Machine Tool Practices I

METHODS OF INSTRUCTION:

Lecture: Didactic presentations will include lecture, video and demonstrations.

Laboratory: Laboratory will be a "hands-on" manufacturing assignments which will require the use of problem solving skills by the students.

Method of Evaluation: A student's grade will be based on multiple measures of performance. The assessment will measure development of independent critical thinking skills and will include evaluation of the student's ability to:

1. perform the manipulative skills of the craft as required to satisfactorily complete laboratory assignments
2. apply theory to laboratory assignments
3. satisfactorily perform on written, oral, and practical examinations
4. satisfactorily perform on outside assignments including writing assignments
5. contribute to class discussions
6. maintain attendance per current policy
7. follow all shop rules and safety regulations as stated in the laboratory manual

LECTURE OUTLINE:

Lecture content will be determined by the instructor based on the manufacturing-related exercise(s) which have been selected for the students.

Total Lecture Hours **48**

LAB OUTLINE:

Lab activities will be determined by the instructor based on the manufacturing-related exercise(s) which have been selected for the students.

Total Lab Hours **72**

COURSE OBJECTIVES: TECHNICAL COMPETENCIES

Technical competencies will be determined for each individual class. The instructor will select certain manufacturing-related problem solving/troubleshooting exercises which will simulate problems in "the real world." Students will work in teams to solve these problems. This may require machine maintenance, tool/fixture building, or any other activities which will lead to the successful completion of the required assignment. Technical competencies will be covered which will reinforce or strengthen the training/education the students have received in prior courses.

COURSE OBJECTIVES: SCANS COMPETENCIES

The Secretary's Commission on Achieving Necessary Skills (SCANS), U.S. Department of Labor, has identified in its "AMERICA 2000 REPORT" that all students should develop a new set of competencies and foundation skills if they are to enjoy a productive, full and satisfying life. These are in addition to the Technical Workplace Competencies required by industry. SCANS is made up of five competencies and a three-part foundation of skills and personal qualities that are needed for solid job performance.

***** **THIS COURSE CAN BE CONSIDERED TO BE SCANS INTENSIVE DUE TO THE NATURE AND STRUCTURE OF THE COURSE.**

The following activities will be performed by each student for successful completion of this course:

I. COMPETENCIES

A. ***Resources:*** *Identifies, organizes, plans, and allocates resources*
Students will draw from information learned in their other classes to identify problems, organize and plan work, and allocate resources necessary to solve assigned manufacturing-related problems.

B. ***Interpersonal:*** *Works with others*
Emphasis will be on working in teams to identify, solve and document solutions to assigned manufacturing-related problems.

C. ***Information:*** *Acquires and uses information*
Students will draw from information learned in their other classes to identify problems, organize and plan work, and allocate resources necessary to solve assigned manufacturing-related problems.

D. ***Systems:*** *Understands complex inter-relationships*
Students will draw from information learned in their other classes to identify problems, organize and plan work, and allocate resources necessary to solve assigned manufacturing-related problems.

E. ***Technology:*** *Works with a variety of technologies*
Students will draw from information learned in their other classes to identify problems, organize and plan work, and allocate resources necessary to solve assigned manufacturing-related problems. Students will be teamed up with students from other disciplines and expected to communicate and work with a variety of technologies to complete the course assignments.

II. FOUNDATION SKILLS

A. ***Basic Skills:*** *Reads, writes, performs arithmetic and mathematical operations, listens and speaks.*

1. ***Reading:*** *Locates, understands, and interprets written information in prose and in documents such as manuals, graphs, and schedules*
Students will be expected to use research techniques to find solutions to assigned work. This may include using machinery manuals and charts to troubleshoot equipment.

2. ***Writing:*** *Communicates thoughts, ideas, information, and messages in writing; and creates documents such as letters, directions, manuals, reports, graphs, and flow charts*
Students will be expected to document the steps required to complete the assigned work. Students will also be expected to write a final summary of the work performed in class.

3. ***Arithmetic/Mathematics:*** *Perform basic computations and approaches practical problems by choosing appropriately from a variety of mathematical techniques*
Students may be expected to perform any computations necessary for the completion of their tasks.

4. ***Listening:*** *Receives, attends to, interprets, and responds to verbal messages and other cues*
Students will have to communicate with the instructor and the other team members to successfully complete their tasks. Listening skills will be of paramount importance in this class.

5. ***Speaking:*** *Organizes ideas and communicates orally*
Students will be expected to communicate effectively with the instructor and the other team members to successfully complete their tasks. Each

student will be required to give a short (5-10 minute) final oral presentation of their findings/observations taken from the course.

B. ***Thinking Skills:*** *Thinks creatively, makes decisions, solves problems, visualizes, knows how to learn and reasons.*

1. ***Decision Making:*** *Specifies goals and constraints, generates alternatives, considers risks, and evaluates and chooses best alternative*
   Students will be required to determine goals and constraints, generate alternative solutions, consider risks/costs, and evaluate and choose the best alternative to satisfy the requirements of the course.
2. ***Problem Solving:*** *Recognizes problems and devises and implements plan of action*
   Students will be expected to recognize problems, devise, and implement a plan of action.
3. ***Seeing Things In the Mind's Eye:*** *Organizes, and processes symbols, pictures, graphs, objects, and other information*
   Students will be encouraged to organize, and process symbols, pictures, graphs, objects, and other information in order to solve specific manufacturing-related problems.
4. ***Knowing How to Learn:*** *Use efficient learning techniques to acquire and apply new knowledge and skills*
   Student learning will be accomplished through problem solving techniques and team learning.
5. ***Reasoning:*** *Discovers a rule or principle underlying the relationship between two or more objects and applies it when solving a problem*
   The format of this class is such that students will be working more with abstract concepts rather than absolute facts. This will help students to develop thinking and reasoning skills.

C. ***Personal Qualities:*** *Displays responsibility, self-esteem, sociability, self-management, and integrity and honesty.*

1. ***Responsibility:*** *Exerts a high level of effort and perseveres towards goal attainment*
   Successful completion of the course will come only after students have spent sufficient time and efforts in identifying problems, organizing and planning work, and allocating resources necessary to solve assigned manufacturing-related problems.
2. ***Self-Esteem:*** *Believes in own self-worth and maintains a positive view of self*
   Students will be encouraged to use the information learned in their other classes to solve practical assignments. Successful completion of this course helps students achieve more of a positive view of their self.
3. ***Sociability:*** *Demonstrates understanding, friendliness, adaptability, empathy, and politeness in group settings*
   Group problem solving activities will develop understanding, friendliness, adaptability, empathy, and politeness towards other team members.

4. ***Self-Management:*** *Assesses self accurately, sets personal goals, monitors progress, and exhibits self-control*
   Each team will be self managed. Team members will be expected to set goals, assess progress accurately, monitor their progress, and exhibit self-control.
5. ***Integrity/Honesty:*** *Chooses ethical courses of action*
   Students will be expected to make reasonable contributions to team efforts and choose to do things the "right" way.

APPENDIX A - INDUSTRY COMPETENCY PROFILES

The following pages contain the individual Competency Profiles for each of the companies surveyed by the MAST development center for the occupational specialty area of . These Competency Profiles/skill standards were used to develop the curriculum for the pilot program.

The participation of the companies as partners in the MAST effort is greatly appreciated. Each company has approved the use of its logo in MAST materials. None of the participating companies shall be held responsible or liable for any of the findings of the project.

SKILLS AND KNOWLEDGE

Communication Skills
Use Measurement Tools
Use Inspection Devices
Mathematical Skills
Reading/Writing Skills
Knowledge of Safety Regulations
Practice Safety in the Workplace
Organizational Skills
Knowledge of Company Policies/Procedures
Mechanical Aptitude
Ability to Comprehend Written/Verbal Instructions
Basic Knowledge of Fasteners
Ability to Work as Part of a Team
Converse in the Technical Language of the Trade
Knowledge of Occupational Opportunities
Knowledge of Employee/Employer Responsibilities
Knowledge of Company Quality Assurance Activities
Practice Quality-Consciousness in Performance of the Job

SPRINGFIELD TECHNICAL COMMUNITY COLLEGE MAST PROGRAM REPRESENTATIVES

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Director of Technology Development

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Senior Secretary/Statistician (TSTC)

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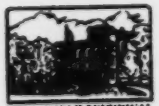
Mike Lyons
Ted Headover
George Zadra
Peter Lasklewicz
Scott Brukins
Ron Boutin
Al Wahler



SPRINGFIELD TECHNICAL COMMUNITY COLLEGE

TRAITS AND ATTITUDES

Strong Work Ethic
Interpersonal Skills
Punctuality
Dependability
Honesty
Neatness
Safety Conscientious
Motivation
Responsible
Physical Ability
Professional
Trustworthy
Customer Relations
Personal Ethics

TOOLS AND EQUIPMENT

Machinist's Tools (e.g., calipers, dial indicators magnetic tool holders, etc.)
Measuring Tools
Power Tools
Metal Lathe with Attachments
Drill Presses
Vertical Mill with Attachments
Power Saws
Power Drills
Hydraulic/Arbor Press
Heat Treatment Equipment
Hardness Testing Equipment
Grinding Machines with Attachments
Welding Equipment (SMAW, GMAW, FCAW, Plasma)
CNC Machining Center and Turning Center
Gear Producing Machines with Attachments
Jig Boring Machines
Alignment/Calibration Tools
Coolant Recovery Equipment
Computer
Ventilation Equipment
Forklift
Personal Safety Equipment
Oxyacetylene Equipment
Tool Storage Equipment
Workbenches
Vises
Pedestal Grinders
Weld Test Equipment
Optical Comparator
Coordinate Measurement Machine
Hydraulic/Pneumatic Training Equipment
Electrical Training Equipment
Safety Training Equipment

FUTURE TRENDS AND CONCERNS

Statistical Process Control
Composites
Laser Machining
Advanced Computer Applications
Robotics
Environmental Concerns
Fiber Optic Controls
Automated Material Handling Equipment
Computer Integrated Manufacturing

COMPETENCY PROFILE

Manufacturing Engineering Technician

Prepared By
M.A.S.T.
Machine Tool Advanced Skills Technology Program
and
Consortia Partners
(V.199J40008)

SPRINGFIELD TECHNICAL COMMUNITY COLLEGE

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MANUFACTURING ENGINEERING TECHNICIAN .... use special knowledge and skills to recommend and/or implement solutions for specific manufacturing applications.

Duties	Tasks												
A Practice Safety	A-1 Follow safety manuals and all safety regulations/ requirements	A-2 Use protective equipment	A-3 Follow safe operating procedures for hand and machine tools	A-4 Maintain a clean and safe work environment	A-5 Control fire hazards	A-6 Apply ergonomic principles to the workplace							
B Apply Mathematical Concepts	B-1 Perform basic arithmetic functions	B-2 Inter-convert fractions/ decimals	B-3 Inter-convert Metric/ English measurements	B-4 Perform basic algebraic operations	B-5 Perform basic trigonometric functions	B-6 Calculate speeds and feeds for machining	B-7 Locate machining points from a datum point	B-8 Perform calculations for sine bar and sine plate	B-9 Calculate for direct, simple, and angular indexing	B-10 Perform calculations necessary for turning tapers	B-11 Solve for little "h"	B-12 Use all functions on a scientific calculator	B-13 Solve engineering equations
	B-14 Solve static systems for resultant force												
C Perform Computer Aided Drafting (CAD)	C-1 Understand PC basics	C-2 Discuss CAD basics and file management	C-3 Use drawing settings	C-4 Perform basic editing commands	C-5 Create drawings with accuracy	C-6 Organize drawing information	C-7 Control the display of drawings	C-8 Use intermediate drawing commands	C-9 Perform intermediate editing commands	C-10 Create multiview drawings	C-11 Create sectioned drawings	C-12 Investigate basic dimensioning	C-13 Perform advanced dimensioning
	C-14 Use and manipulate blocks	C-15 Use blocks to automate the drawing process											
D Recognize Different Manufacturing Materials and Processes	D-1 Identify materials with desired properties	D-2 Describe heat treating processes	D-3 Perform heat treating operations	D-4 Test metal samples for hardness	D-5 Describe casting processes	D-6 Describe hot working processes	D-7 Describe cold working processes	D-8 Evaluate alternative manufacturing processes					
E Perform Measurement & Inspection	E-1 Study basics of metrology	E-2 Select instruments used for measurement	E-3 Interpret limits and tolerances	E-4 Select gagging tools	E-5 Use CMM for location of features	E-6 Perform surface metrology	E-7 Perform measurement by comparison	E-8 Perform circularity, cylindricity, profile of a line, and runout measurements	E-8 Investigate advanced metrology topics				
F Perform Conventional Machining Operations	F-1 Prepare and plan for machining operations	F-2 Use proper hand tools	F-3 Operate power saws	F-4 Operate drill presses	F-5 Operate vertical milling machines	F-6 Operate horizontal milling machines	F-7 Operate metal cutting lathes	F-8 Operate grinding/ abrasive machines					
G Perform CNC Programming	G-1 Apply machine specific (milling and lasers) nomenclature and terminology	G-2 Investigate the Cartesian coordinate system as applied to milling and laser machines	G-3 Apply CNC programming language	G-4 Perform start up, tool changing, and ending of programs	G-5 Perform positioning and basic drilling	G-6 Create a sub-program	G-7 Use position and fixed cycles	G-8 Perform contouring	G-9 Apply tool radius compensation (cutter comp)	G-10 Perform programming preparation	G-11 Apply special laser coding parameters		
H Perform Computer Aided Manufacturing (CAM)	H-1 Understand the basics of a PC based CAM system	H-2 Discuss basic CAM operations	H-3 Set up cutting tools	H-4 Create part profiles	H-5 Edit part profiles	H-6 Perform advanced editing of part profiles	H-7 Edit tool paths	H-8 Perform drilling and counterboring	H-9 Use construction layers in SmartCAM	H-10 Perform user commands and machine events	H-11 Create families of parts	H-12 Perform CAD/CAM integration	H-13 Perform code generation

Duties	Tasks												
I Participate in Total Quality and SPC Activities	I-1 Define quality in manufacturing and explain importance	I-2 Implement concepts of quality in the workplace	I-3 Apply principles and tools of continuous quality improvement	I-4 Understand and apply SPC	I-5 Evaluate data to monitor production	I-6 Analyze customer problems and recommend solutions	I-7 Establish methods, plans and procedures to maintain quality						
J Maintain Electrical Devices	J-1 Use electrical test equipment	J-2 Apply specific terms to electrical circuits	J-3 Analyze series, parallel and complex DC/AC circuits	J-4 Check AC and DC motors	J-5 Inspect transformers and generators	J-6 Discuss sensors and feedback technology	J-7 Set up/ program PLC	J-8 Trouble-shoot electrical devices					
K Maintain Hydraulic/ Pneumatic Devices	K-1 Use test equipment	K-2 Describe basic principles of hydraulic systems	K-3 Identify hydraulic fluids	K-4 Recommend power distribution and sealing devices	K-5 Recognize pumps, actuators, and hydraulic control devices	K-6 Trouble-shoot hydraulic/pneumatic systems							
L Study Production and Operations Management	L-1 Investigate the concepts of product design												
M Define and Use Automated Systems	M-1 Study manufacturing cells	M-2 Identify automation sensors	M-3 perform robot programming	M-4 Use vision systems									

SKILLS AND KNOWLEDGE

Communication Skills
Use Measurement Tools
Use Inspection Devices
Mathematical Skills
Reading/Writing Skills
Knowledge of Safety Regulations
Practice Safety in the Workplace
Organizational Skills
Knowledge of Company Policies/Procedures
Mechanical Aptitude
Ability to Comprehend Written/Verbal Instructions
Knowledge of Cutting Fluids/Lubricants
Basic Knowledge of Fasteners
Ability to Work as Part of a Team
Converse in the Technical Language of the Trade
Knowledge of Occupational Opportunities
Knowledge of Employee/Employer Responsibilities
Knowledge of Company Quality Assurance Activities
Practice Quality-Consciousness in Performance of the Job

TEXAS STATE TECHNICAL COLLEGE WACO
MAST PROGRAM REPRESENTATIVES

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Senior Secretary/Statistician

Facilitated By:
DR. JON BOTSFORD
Associate Dean
Manufacturing/Process/
Information Technologies
Division

Texas State Technical College Waco

TRAITS AND ATTITUDES

Interpersonal Skills
Punctuality
Dependability
Honesty
Neatness
Safety Conscientious
Motivation
Responsible
Physical Ability
Professional
Trustworthy
Customer Relations
Personal Ethics

TOOLS AND EQUIPMENT

Machinist's Tools (e.g., calipers, dial indicators, magnetic tool holders, etc.)
Measuring Tools
Power Tools
Metal Lathe with Attachments
Drill Presses
Vertical Mill with Attachments
Power Saws
Power Drills
Hydraulic/Arbor Press
Heat Treatment Equipment
Hardness Testing Equipment
Grinding Machines with Attachments
Welding Equipment (SMAW, GMAW, FCAW, Plasma)
CNC Machining Center and Turning Center
Gear Producing Machines with Attachments
Jig Boring Machines
Alignment/Calibration Tools
Coolant Recovery Equipment
Computer
Ventilation Equipment
Forklift
Personal Safety Equipment
Oxyacetylene Equipment
Tool Storage Equipment
Workbenches
Vises
Pedestal Grinders
Weld Test Equipment
Optical Comparator
Coordinate Measurement Machine
Hydraulic/Pneumatic Training Equipment
Electrical Training Equipment
Safety Training Equipment

FUTURE TRENDS AND CONCERNS

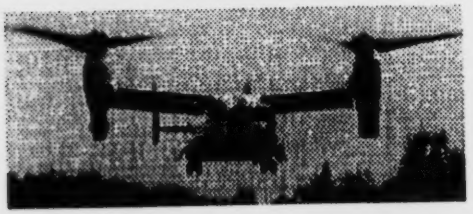
Statistical Process Control
Composites
Laser Machining
Advanced Computer Applications
Robotics
Environmental Concerns
Fiber Optic Controls
Automated Material Handling Equipment
Computer Integrated Manufacturing

COMPETENCY PROFILE
Manufacturing Engineering Technician

Conducted By
M.A.S.T.
Machine Tool Advanced Skills
Technology Program
and
Consortia Partners
(V.199J40008)

Texas State Technical College Waco

Bell Helicopter TEXTRON



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MANUFACTURING ENGINEERING TECHNICIAN .... use special knowledge and skills to recommend and/or implement solutions for specific manufacturing applications.

Duties	Tasks												
A Interpret Engineering Drawings and Control Documents	A-1 Review blueprint notes and dimensions	A-2 Identify basic layout of drawings	A-3 Identify basic types of drawings	A-4 List the purpose of each type of drawing	A-5 Verify drawing elements	A-6 Identify lines and symbols (GD&T)	A-7 Understand the relationship of engineering drawings to planning	A-8 Use standards to verify requirements	A-9 Analyze bill of materials				
B Understand Manufacturing Materials and Processes	B-1 Select materials with desired properties	B-2 Identify materials and processes to produce a product	B-3 Identify heat treating processes	B-4 Thermal process workpieces	B-5 Test metal samples	B-6 Discuss casting processes	B-7 Discuss hot working processes	B-8 Discuss cold working processes	B-9 Evaluate alternative manufacturing processes				
C Demonstrate Measurement/ Inspection Techniques	C-1 Identify types of measurements	C-2 Practice proper measuring skills	C-3 Select proper measurement tools	C-4 Use Metric and English standards of measurement	C-5 Perform measurements with hand held instruments	C-6 Perform measurements on surface plate	C-7 Perform inspections using stationary equipment						
D Perform Conventional Machining Operations	D-1 Prepare and plan for machining operations	D-2 Use proper hand tools	D-3 Operate power saws	D-4 Operate drill presses	D-5 Operate vertical milling machines	D-6 Operate horizontal milling machines	D-7 Operate metal cutting lathes	D-8 Operate grinding machines					
E Perform Advanced Machining Processes	E-1 Program CNC machine	E-2 Operate CNC machining centers and turning centers	E-3 Operate electrical discharge machines	E-4 Operate CNC grinders	E-5 Operate CNC jig boring machines	E-6 Download programs via network							
F Perform Gear Generating Operations	F-1 Describe the different types of gears	F-2 Understand gear terms and calculations	F-3 Calculate for direct, simple, and angular indexing	F-4 Use rotary tables and dividing heads	F-5 Make calculations for gear cutting	F-6 Discuss gear inspection							
G Perform Welding Operations	G-1 Weld with SMAW process	G-2 Weld/cut with oxyacetylene	G-3 Weld with GTAW (Heliarc)	G-4 Weld with GMAW (Mig) / FCAW	G-5 Perform Plasma Arc Cutting (PAC)								
H Perform Drafting Tasks	H-1 Demonstrate traditional drafting skills	H-2 Interpret and apply GD&T methodology	H-3 Use CAD systems	H-4 Create 3-D solid models	H-5 Make tool drawings								
I Use Computers	I-1 Use computer operating systems	I-2 Use computer inquiry systems	I-3 Use various computer applications	I-4 Recommend and implement CIM technologies									
J Participate in Total Quality and SPC Activities	J-1 Define quality in manufacturing and explain importance	J-2 Implement concepts of quality in the workplace	J-3 Apply principles and tools of continuous improvement	J-4 Understand and apply SPC	J-5 Evaluate data to monitor production	J-6 Analyze customer problems and recommend solutions	J-7 Establish methods, plans and procedures to maintain quality						

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Duties	Tasks												
K Maintain Electrical Devices	K-1 Use electrical test equipment	K-2 Apply specific terms to electrical circuits	K-3 Analyze series, parallel and complex AC and DC circuits	K-4 Check AC and DC motors	K-5 Inspect transformers and generators	K-6 Discuss sensors and feedback concepts	K-7 Set up/ program Programmable Logic Controller	K-8 Trouble-shoot electrical devices					
L Perform Engineering Calculations	L-1 Use all functions on scientific calculator	L-2 Perform basic algebraic operations	L-3 Perform trigonometric functions	L-4 Solve engineering equations	L-5 Solve static systems for resultant force	L-6 Determine strength of materials	L-7 Use Computer Aided Engineering system						
M Maintain Hydraulics and Pneumatic	M-1 Use test equipment	M-2 Describe basic principles of hydraulic/ pneumatic systems	M-3 Identify hydraulic fluids	M-4 Recommend power distribution and sealing devices	M-5 Recognize pumps, actuators, and control devices	M-6 Trouble-shoot hydraulic/pneumatic systems							
N Interpret Safety Regulations	N-1 Apply safety manual directives	N-2 Control fire hazards	N-3 Apply American Red Cross first aid and CPR procedures	N-4 Recommend hazardous waste management techniques	N-5 Apply ergonomic principles to the workplace	N-6 Demonstrate knowledge of state and federal EPA regulations							

Bell Helicopter TEXTRON
DACUM Panel Members

LUCIEN ROUZE
Department of Employee Training and Development

DAVE PEARL
Administrator of Human Resource Development

MILTON R. SIEMS
Senior Consultant of Human Resource Development

ROBERT D. SWANSON
Administrator of Human Resource Development

JOHN P. DAVIS
International Training Program Manager

JAMES R. HELMICK, JR.
Manufacturing Engineer

SKILLS AND KNOWLEDGE

Communication Skills
Use Measurement Tools
Use Inspection Devices
Mathematical Skills
Reading/Writing Skills
Knowledge of Safety Regulations
Practice Safety in the Workplace
Organizational Skills
Knowledge of Company Policies/Procedures
Mechanical Aptitude
Ability to Comprehend Written/Verbal Instructions
Basic Knowledge of Fasteners
Ability to Work as Part of a Team
Converse in the Technical Language of the Trade
Knowledge of Occupational Opportunities
Knowledge of Employee/Employer Responsibilities
Knowledge of Company Quality Assurance Activities
Practice Quality-Consciousness in Performance of the Job

TEXAS STATE TECHNICAL COLLEGE WACO
MAST PROGRAM REPRESENTATIVES

DR. HUGH K. ROGERS
Director

DR. JON BOTSFORD
Assistant Director

JOE PENICK
Project Coordinator

TERRY SAWMA
Research Coordinator

WALLACE PELTON
Site Coordinator

ROSE MARY TIMMONS
Senior Secretary/Statistician

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Assistant Director of Manufacturing

RICHARD M. WONG
Sr. Manufacturing Engineer

RICKY JOHNSON
Manufacturing Engineering Technician

BOB GRUPA
Manufacturing Engineering Technician

Texas State Technical College Waco

TRAITS AND ATTITUDES

Strong Work Ethic
Interpersonal Skills
Punctuality
Dependability
Honesty
Neatness
Safety Conscientious
Motivation
Responsible
Physical Ability
Professional
Trustworthy
Customer Relations
Personal Ethics

TOOLS AND EQUIPMENT

Machinist's Tools (e.g., calipers, dial indicators magnetic tool holders, etc.)
Measuring Tools
Power Tools
Metal Lathe with Attachments
Drill Presses
Vertical Mill with Attachments
Power Saws
Power Drills
Hydraulic/Arbor Press
Heat Treatment Equipment
Hardness Testing Equipment
Grinding Machines with Attachments
Welding Equipment (SMAW, OMAW, FCAW, Plasma)
CNC Machining Center and Turning Center
Gear Producing Machines with Attachments
Jig Boring Machines
Alignment/Calibration Tools
Coolant Recovery Equipment
Computer
Ventilation Equipment
Forklift
Personal Safety Equipment
Oxyacetylene Equipment
Tool Storage Equipment
Workbenches
Vises
Pedestal Grinders
Weld Test Equipment
Optical Comparator
Coordinate Measurement Machine
Hydraulic/Pneumatic Training Equipment
Electrical Training Equipment
Safety Training Equipment

FUTURE TRENDS AND CONCERNS

Statistical Process Control
Composites
Laser Machining
Advanced Computer Applications/Networking
Robotics/Vision Systems
Environmental Concerns
Fiber Optic Controls
Automated Material Handling Equipment
Computer Integrated Manufacturing

COMPETENCY PROFILE

Manufacturing Engineering Technician

Prepared By
M.A.S.T.
Machine Tool Advanced Skills Technology Program
and
Consortia Partners
(V.199J40008)

Texas State Technical College Waco

BOWEN®

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MANUFACTURING ENGINEERING TECHNICIAN .... use special knowledge and skills to recommend and/or implement solutions for specific manufacturing applications.

Duties	Tasks												
A Practice Safety	A-1 Follow safety manuals and all safety regulations/ requirements	A-2 Use protective equipment	A-3 Follow safe operating procedures for hand and machine tools	A-4 Maintain a clean and safe work environment	A-5 Control fire hazards	A-6 Apply American Red Cross First Aid and CPR procedures	A-7 Recommend hazardous waste management techniques	A-8 Apply ergonomic principles to the workplace	A-9 Demonstrate knowledge of state and federal EPA regulations				
B Apply Mathematical Concepts	B-1 Perform basic arithmetic functions	B-2 Interconvert fractions/ decimals	B-3 Interconvert Metric/ English measurements	B-4 Perform basic algebraic operations	B-5 Perform basic trigonometric functions	B-6 Calculate speeds and feeds for machining	B-7 Locate machining points from a datum point	B-8 Perform calculations for sine bar and sine plate	B-9 Calculate for direct, simple, and angular indexing	B-10 Perform calculations necessary for turning tapers	B-11 Solve for little "h"	B-12 Use all functions on a scientific calculator	B-13 Solve engineering equations
	B-14 Solve static systems for resultant forces	B-15 Determine strength of materials for various applications											
C Interpret Engineering Drawings and Control Documents	C-1 Review blueprint notes and dimensions	C-2 Identify basic layout of drawings	C-3 Identify basic types of drawings	C-4 List the purpose of each type of drawing	C-5 Verify drawing elements	C-6 Practice Geometric Dimensioning and Tolerancing (GD&T) methodology	C-7 Describe the relationship of engineering drawings to planning	C-8 Use standards to verify requirements	C-9 Analyze bill of materials (BOM)	C-10 Understand and use quality systems			
D Recognize Different Manufacturing Materials and Processes	D-1 Identify materials with desired properties	D-2 Identify materials and processes to produce a product	D-3 Describe heat treating processes	D-4 Perform heat treating operations	D-5 Test metal samples for hardness	D-6 Describe casting processes	D-7 Describe hot working processes	D-8 Describe cold working processes	D-9 Evaluate alternative manufacturing processes				
E Demonstrate Measurement/ Inspection Techniques	E-1 Identify types of measurement used in manufacturing	E-2 Select proper measurement tools	E-3 Apply proper measuring techniques	E-4 Use Metric and English standards of measurement	E-5 Perform measurements with hand held instruments	E-6 Perform measurements on surface plate	E-7 Perform inspections using stationary equipment						
F Perform Conventional Machining Operations	F-1 Prepare and plan for machining operations	F-2 Use proper hand tools	F-3 Operate power saws	F-4 Operate drill presses	F-5 Operate vertical milling machines	F-6 Operate horizontal milling machines	F-7 Operate metal cutting lathes	F-8 Operate grinding/ abrasive machines					
G Perform Advanced Machining Processes	G-1 Prepare and plan for CNC machining operations	G-2 Select and use CNC tooling systems	G-3 Program CNC machines	G-4 Operate CNC machining centers (mills)	G-5 Operate CNC turning centers (lathes)	G-6 Operate electrical discharge machines	G-7 Download programs via network						
H Perform Gear Generating Operations	H-1 Describe the different types of gears	H-2 Understand gear terms	H-3 Use rotary tables and dividing heads	H-4 Discuss gear inspection and measurement									
I Perform Welding Operations	I-1 Weld with Shielded Metal Arc Welding (SMAW) process	I-2 Weld/cut with oxyacetylene	I-3 Weld with Gas Tungsten Arc Welding (GTAW) (Heliarc)	I-4 Weld with Gas Metal Arc Welding (GMAW)(Mig) and Flux Core Arc Welding (FCAW)	I-5 Perform Plasma Arc Cutting (PAC)								

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Duties	Tasks												
J Perform Drafting Tasks	J-1 Demonstrate traditional mechanical drafting skills	J-2 Use Computer-Aided Drafting (CAD) system	J-3 Create 3-D solid models	J-4 Make tool drawings	J-5 Recommend tool design								
K Use Computers	K-1 Use computer operating systems	K-2 Use computer inquiry systems	K-3 Use various computer applications	K-4 Recommend and implement CIM technologies	K-5 Use computer-aided engineering system								
L Perform Layout and Design for Production	L-1 Recommend tooling for specific machines	L-2 Solve production set-up problems	L-3 Recommend shop floor layout and routing	L-4 Provide cost information needed for quotes or cost analysis									
M Participate in Total Quality and SPC Activities	M-1 Define quality in manufacturing and explain importance	M-2 Implement concepts of quality in the workplace	M-3 Apply principles and tools of continuous quality improvement	M-4 Understand and apply SPC	M-5 Evaluate data to monitor production	M-6 Analyze customer problems and recommend solutions	M-7 Establish methods, plans and procedures to maintain quality						
N Maintain Electrical Devices	N-1 Use electrical test equipment	N-2 Apply specific terms to electrical circuits	N-3 Analyze series, parallel and complex DC/AC circuits	N-4 Check AC and DC motors	N-5 Inspect transformers and generators	N-6 Discuss sensors and feedback technology	N-7 Set up/ program PLC	N-8 Trouble-shoot electrical devices					
O Maintain Hydraulics/ Pneumatic Devices	O-1 Use test equipment	O-2 Describe basic principles of hydraulic systems	O-3 Identify hydraulic fluids	O-4 Recommend power distribution and sealing devices	O-5 Recognize pumps, actuators, and hydraulic control devices	O-6 Trouble-shoot hydraulic/pneumatic systems							

SKILLS AND KNOWLEDGE

Communication Skills
Use Measurement Tools
Use Inspection Devices
Mathematical Skills
Reading/Writing Skills
Knowledge of Safety Regulations
Practice Safety in the Workplace
Organizational Skills
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SPRINGFIELD TECHNICAL COMMUNITY COLLEGE
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Furnished By:

DEVON PRECISION INDUSTRIES, INC.

MICHAEL ROWLEY
Manufacturing Engineer

SPRINGFIELD TECHNICAL COMMUNITY COLLEGE

TRAITS AND ATTITUDES

Strong Work Ethic
Interpersonal Skills
Punctuality
Dependability
Honesty
Neatness
Safety Conscientious
Motivation
Responsible
Physical Ability
Professional
Trustworthy
Customer Relations
Personal Ethics

TOOLS AND EQUIPMENT

Machinist's Tools (e.g., calipers, dial indicators magnetic tool holders, etc.)
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Vertical Mill with Attachments
Power Saws
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Welding Equipment (SMAW, GMAW, FCAW, Plasma)
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Tool Storage Equipment
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Optical Comparator
Coordinate Measurement Machine
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Electrical Training Equipment
Safety Training Equipment

FUTURE TRENDS AND CONCERNS

Statistical Process Control
Composites
Laser Machining
Advanced Computer Applications
Robotics
Environmental Concerns
Fiber Optic Controls
Automated Material Handling Equipment
Computer Integrated Manufacturing

COMPETENCY PROFILE

Manufacturing Engineering Technician

Prepared By
M.A.S.T.
Machine Tool Advanced Skills Technology Program
and
Consortia Partners
(V.199J40008)

SPRINGFIELD TECHNICAL COMMUNITY COLLEGE

DEVON
Precision Industries Inc.

MANUFACTURING ENGINEERING TECHNICIAN .... use special knowledge and skills to recommend and/or implement solutions for specific manufacturing applications.

Duties	Tasks												
A Practice Safety	A-1 Follow safety manuals and all safety regulations/ requirements	A-2 Use protective equipment	A-3 Follow safe operating procedures for hand and machine tools	A-4 Maintain a clean and safe work environment	A-5 Control fire hazards	A-6 Apply American Red Cross First Aid and CPR procedures	A-7 Recommend hazardous waste management techniques	A-8 Apply ergonomic principles to the workplace	A-9 Demonstrate knowledge of state and federal EPA regulations				
B Apply Mathematical Concepts	B-1 Perform basic arithmetic functions	B-2 Inter-convert fractions/ decimals	B-3 Inter-convert Metric/ English measurements	B-4 Perform basic algebraic operations	B-5 Perform basic trigonometric functions	B-6 Calculate speeds and feeds for machining	B-7 Locate machining points from a datum point	B-8 Perform calculations for sine bar and sine plate	B-9 Calculate for direct, simple, and angular indexing	B-10 Perform calculations necessary for turning tapers	B-11 Solve for little "h"	B-12 Use all functions on a scientific calculator	B-13 Solve engineering equations
	B-14 Solve static systems for resultant force	B-15 Determine strength of materials for various applications											
C Perform Computer Aided Drafting (CAD)	C-1 Understand PC basics	C-2 Discuss CAD basics and file management	C-3 Use drawing settings	C-4 Perform basic editing commands	C-5 Create drawings with accuracy	C-6 Organize drawing information	C-7 Control the display of drawings	C-8 Use intermediate drawing commands	C-9 Perform intermediate editing commands	C-10 Create multiview drawings	C-11 Create sectioned drawings	C-12 Investigate basic dimensioning	C-13 Perform advanced dimensioning
	C-14 Use and manipulate blocks	C-15 Use blocks to automate the drawing process											
D Recognize Different Manufacturing Materials and Processes	D-1 Identify materials with desired properties	D-2 Describe heat treating processes	D-3 Perform heat treating operations	D-4 Test metal samples for hardness	D-5 Describe casting processes	D-6 Describe hot working processes	D-7 Describe cold working processes	D-8 Evaluate alternative manufacturing processes					
E Perform Measurement and Inspection	E-1 Study basics of metrology	E-2 Select instruments used for measurement	E-3 Interpret limits and tolerances	E-4 Select gaging tools	E-5 Use CMM for location of features	E-6 Perform surface metrology	E-7 Perform measurement by comparison	E-8 Perform circularity, cylindricity, profile of a line, and runout measurements	E-9 Investigate advanced metrology topics				
F Perform Conventional Machining Operations	F-1 Prepare and plan for machining operations	F-2 Use proper hand tools	F-3 Operate power saws	F-4 Operate drill presses	F-5 Operate vertical milling machines	F-6 Operate horizontal milling machines	F-7 Operate metal cutting lathes	F-8 Operate grinding/ abrasive machines					
G Perform CNC Programming	G-1 Apply machine specific (milling and laser) nomenclature and terminology	G-2 Investigate the Cartesian coordinate system as applied to milling and laser machines	G-3 Apply CNC programming language	G-4 Perform start up, tool changing, and ending of programs	G-5 Perform positioning and basic drilling	G-6 Create a sub-program	G-7 Use position and fixed cycles	G-8 Perform contouring	G-9 Apply tool radius compensation (cutter comp)	G-10 Perform programming preparation	G-11 Apply special laser coding parameters		
H Perform Computer Aided Manufacturing (CAM)	H-1 Understand the basics of a PC based CAM system	H-2 Discuss basic CAM operations	H-3 Set up cutting tools	H-4 Create part profiles	H-5 Edit part profiles	H-6 Perform advanced editing of part profiles	H-7 Edit tool paths	H-8 Perform drilling and counterboring	H-9 Use construction layers in SmartCAM	H-10 Perform user commands and machine events	H-11 Create families of parts	H-12 Perform CAD/CAM integration	H-13 Perform code generation

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Duties	Tasks												
I Participate in Total Quality and SPC Activities	I-1 Define quality in manufacturing and explain importance	I-2 Implement concepts of quality in the workplace	I-3 Apply principles and tools of continuous quality improvement	I-4 Understand and apply SPC	I-5 Evaluate data to monitor production	I-6 Analyze customer problems and recommend solutions	I-7 Establish methods, plans and procedures to maintain quality						
J Maintain Electrical Devices	J-1 Use electrical test equipment	J-2 Apply specific terms to electrical circuits	J-3 Analyze series, parallel and complex DC/AC circuits	J-4 Check AC and DC motors	J-5 Inspect transformers and generators	J-6 Discuss sensors and feedback technology	J-7 Set up/ program PLC	J-8 Trouble-shoot electrical devices					
K Maintain Hydraulic/ Pneumatic Devices	K-1 Use test equipment	K-2 Describe basic principles of hydraulic systems	K-3 Identify hydraulic fluids	K-4 Recommend power distribution and sealing devices	K-5 Recognize pumps, actuators, and hydraulic control devices	K-6 Trouble-shoot hydraulic/pneumatic systems							
L Study Production and Operations Management	L-1 Investigate the concepts of product design	L-2 Perform production and inventory planning and control (PIPC)	L-3 Perform forecasting demand for finished products and services	L-4 Perform capacity requirements planning and master production scheduling	L-5 Perform Materials Requirement Planning (MRP I) and Manufacturing Resource Planning (MRP II)	L-6 Study re-order point and re-order quantity methods	L-7 Study low-volume job shop scheduling and control	L-8 Study repetitive and just-in time production scheduling and control	L-9 Study purchasing and vendor management	L-10 Design production and service facility			
M Define and Use Automated Systems	M-1 Study manufacturing cells	M-2 Describe group technology	M-3 Study automated material movement and storage systems	M-4 Discuss robot classification	M-5 Study end-of-arm tooling	M-6 Identify automation sensors	M-7 Implement computer integrated manufacturing with robots	M-8 Perform robot programming	M-9 Use vision systems				

SKILLS AND KNOWLEDGE

Communication Skills
Use Measurement Tools
Use Inspection Devices
Mathematical Skills
Reading/Writing Skills
Knowledge of Safety Regulations
Practice Safety in the Workplace
Organizational Skills
Mechanical Aptitude
Ability to Comprehend Written/Verbal Instructions
Basic Knowledge of Fasteners
Ability to Work as Part of a Team
Converse in the Technical Language of the Trade
Knowledge of Occupational Opportunities
Knowledge of Employee/Employer Responsibilities
Knowledge of Company Quality Improvement Activities
Practice Quality-Consciousness in Performance of the Job

CENTRAL FLORIDA COMMUNITY COLLEGE PROGRAM REPRESENTATIVES

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Dean/Technical Education

MIKE FOX
Director/Industry Services

LARRY MYFORD
Coordinator/Manufacturing Technology

EMERGENCY ONE, INC. MANAGEMENT TEAM AND EXPERT WORKERS

DAN WOMBOLD, Vice President Human Resources
JIM WHITE, Vice President/Manufacturing
BILL RHODES, Production Manager/Body Plant
RON STEPHENS, Human Resources Manager
ELAINE SWIGART, Human Resources Supervisor
DONNA TACKETT, Health & Safety Supervisor
JEFF OSTEEN, Supervisor
JEFF HOURIGAN, Supervisor

TRAITS AND ATTITUDES

Strong Work Ethic
Interpersonal Skills
Punctuality
Dependability
Honesty
Neatness
Safety Awareness
Motivation
Responsible
Physical Ability
Professional
Trustworthy
Customer Relations
Personal Ethics

TOOLS AND EQUIPMENT

Safety Glasses
Hearing Protection
Safety Shoes
Required Clothing
Computer Terminal System
Microcomputer
Drill Motors
Screw Guns
Rivet Guns
Impact Guns
Sanders
Grinders
Power Saws
Torque Wrenches
Combination Square
General Tools (tape measure, hand wrenches, screwdrivers, socket tools, hammers)
Taps and Dies
Calibration Tools
Ventilation Equipment
Workbenches
Vises
Air-powered Jig
Dynafile
Air Ratchet
Dual-action Grinder
Hole Saw

FUTURE TRENDS AND CONCERNS

Assembly of Composite Materials
Advanced Computer Applications
Environmental Concerns
Use of Automated Handling Equipment

COMPETENCY PROFILE

Manufacturing/Assembly Technician

Prepared by
Central Florida Community College

and
Emergency One, Inc.

December 1995

MANUFACTURING/ASSEMBLY TECHNICIAN

Duties ← **Tasks** →

Duties													
A Practice Safety	A-1 Demonstrate understanding of safety rules	A-2 Assume personal safety standards for self and others	A-3 Support all safety practices and use protective equipment	A-4 Demonstrate an understanding of proper hazardous material handling	A-5 Know first aid and CPR	A-6 Practice safety in the use of tools							
B Practice Total Quality	B-1 Apply principles and tools of continuous quality improvement	B-2 Understand the importance of quality in manufacturing process	B-3 Implement concepts of quality in the workplace	B-4 Follow the Quality Plan and recommend improvements in work methods or tooling	B-5 Establish methods, plans and procedures to maintain quality								
C Work Ethics	C-1 Be prompt and on the job in accordance with work schedule	C-2 Value honest work ethics, dedication, and responsibility in the workplace	C-3 Demonstrate high moral values	C-4 Display a neat and clean workplace	C-5 Practice careful use and maintenance of tools and equipment	C-6 Be committed to excellence and quality	C-7 Present a good company image in attire and attitude	C-8 Support a positive work environment	C-9 Practice a positive attitude				
D Demonstrate Communication Skills	D-1 Be an active listener	D-2 Demonstrate good reading, comprehension, and writing skills	D-3 Be able to document manufacturing procedures	D-4 Be able to prepare recommendations for continuous improvement	D-5 Summarize and prioritize work responsibilities	D-6 Be able to give and follow directions and accept constructive criticism	D-7 Be able to verbally communicate with co-workers and management						
E Work as a Team	E-1 Understand the roles of co-workers	E-2 Respect peer relationships	E-3 Share resources to accomplish necessary tasks	E-4 Facilitate the work ethic by completing tasks on time and accurately	E-5 Be involved with problem solving	E-6 Apply creative thinking	E-7 Support a positive attitude	E-8 Encourage good feelings and morale	E-9 Understand purpose and goals of the organization	E-10 Plan and organize work as a team	E-11 Be willing to lead in areas of knowledge and expertise	E-12 Demonstrate willingness to learn new methods and skills	E-13 Demonstrate good working relationships with others
F Mathematical Skills	F-1 Exhibit understanding of basic arithmetic functions	F-2 Exhibit understanding of converting fractions and decimals	F-3 Demonstrate practical mathematics in the use of measurement tools	F-4 Interconvert Metric/English measurements	F-5 Perform practical mathematical applications relevant to area of work	F-6 Use applied statistics, graphs, and charts for purpose of analysis and problem-solving							
G Engineering Drawings and Control Documents	G-1 Demonstrate ability to comprehend blueprint notes and dimensions	G-2 Identify and understand components of Bill of Materials (BOM)	G-3 Demonstrate knowledge of Material Pick List	G-4 Follow company production schedule and use control documents									
H Demonstrate Basic Computer Skills	H-1 Understand workplace applications of the company's computer system	H-2 Demonstrate ability to perform basic functions on microcomputer	H-3 Understand the basics of bar coder and bar code reader										
I Tools and Equipment	I-1 Demonstrate ability to identify, match need, and properly use air-operated tools	I-2 Demonstrate ability to identify, match need, and properly use electric-operated tools	I-3 Demonstrate ability to identify, match need, and properly use common hand tools	I-4 Understand the capabilities/limitations of a wide variety of hand/power tools	I-5 Follow assembly specifications using proper tools	I-6 Display ability to correctly read dials, tape measure and pressure gauges							
J Emergency Vehicle Terminology	J-1 Display a general understanding of emergency vehicle terminology	J-2 Understand the functions of equipment being assembled	J-3 Understand how components relate as a total system										

MANUFACTURING/ASSEMBLY TECHNICIAN...continued

Duties ← **Tasks** →

K Manufacturing Materials and Processes	K-1 Identify materials with desired properties and strengths	K-2 Identify materials and assembly operations needed	K-3 Understand the importance of proper fit and torque values	K-4 Understand the capability and use of cutters and grinders	K-5 Identify and use corrosion control procedures and materials							
L Wellness/ Physical Abilities	L-1 Demonstrate ability to lift 50 pounds	L-2 Demonstrate ability to tolerate heights up to 100 feet	L-3 Ability to work from various positions while standing on concrete for extended periods	L-4 Display ability to work in hot/cold environment for 8-10 hours	L-5 Present a history of documented regular attendance at work	L-6 Apply wellness information to lifestyle to maintain health						

SKILLS AND KNOWLEDGE

Communication Skills
Use Measurement Tools
Use Inspection Devices
Mathematical Skills
Reading/Writing Skills
Knowledge of Safety Regulations
Practice Safety in the Workplace
Organizational Skills
Knowledge of Company Policies/Procedures
Mechanical Aptitude
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TEXAS STATE TECHNICAL COLLEGE WACO
MAST PROGRAM REPRESENTATIVES

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Director

DR. JON BOTSFORD
Assistant Director

JOE PENICK
Project Coordinator

TERRY SAWMA
Research Coordinator

WALLACE PELTON
Site Coordinator

ROSE MARY TIMMONS
Senior Secretary/Statistician

Furnished By:

MARTY SCHMIDT
Senior Manufacturing Engineer and Systems Design Engineer

MICHAEL KON
Manufacturing Engineer and CNC Systems/Programs Engineer

Texas State Technical College Waco

TRAITS AND ATTITUDES

Strong Work Ethic
Interpersonal Skills
Punctuality
Dependability
Honesty
Neatness
Safety Conscientious
Motivation
Responsible
Physical Ability
Professional
Trustworthy
Customer Relations
Personal Ethics

TOOLS AND EQUIPMENT

Machinist's Tools (e.g., calipers, dial indicators magnetic tool holders, etc.)
Measuring Tools
Power Tools
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FUTURE TRENDS AND CONCERNS

Statistical Process Control
Composites
Laser Machining
Advanced Computer Applications
Robotics
Environmental Concerns
Fiber Optic Controls
Automated Material Handling Equipment
Computer Integrated Manufacturing

COMPETENCY PROFILE

Manufacturing Engineering Technician

Prepared By
M.A.S.T.
Machine Tool Advanced Skills
Technology Program
and
Consortia Partners
(V.199J40008)

Texas State Technical College Waco

LOCKHEED MARTIN

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MANUFACTURING ENGINEERING TECHNICIAN .... use special knowledge and skills to recommend and/or implement solutions for specific manufacturing applications.

Duties	Tasks												
A Practice Safety	A-1 Follow safety manuals and all safety regulations/ requirements	A-2 Use protective equipment	A-3 Follow safe operating procedures for hand and machine tools	A-4 Maintain a clean and safe work environment	A-5 Control fire hazards	A-6 Apply American Red Cross First Aid and CPR procedures	A-7 Understand hazardous waste management techniques	A-8 Apply ergonomic principles to the workplace	A-9 Demonstrate knowledge of state and federal EPA regulations				
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	B-14 Solve static systems for resultant force	B-15 Determine strength of materials for various applications											
C Interpret Engineering Drawings and Control Documents	C-1 Review blueprint notes and dimensions	C-2 Identify basic layout of drawings	C-3 Identify basic types of drawings	C-4 List the purpose of each type of drawing	C-5 Verify drawing elements	C-6 Practice Geometric Dimensioning and Tolerancing (GD&T) methodology	C-7 Describe the relationship of engineering drawings to planning	C-8 Use standards to verify requirements	C-9 Analyze bill of materials (BOM)	C-10 Understand and use quality systems			
D Recognize Different Manufacturing Materials and Processes	D-1 Identify materials with desired properties	D-2 Identify materials and processes to produce a product	D-3 Describe heat treating processes	D-4 Perform heat treating operations	D-5 Test metal samples for hardness	D-6 Describe casting processes	D-7 Describe hot working processes	D-8 Describe cold working processes	D-9 Evaluate alternative manufacturing processes				
E Demonstrate Measurement/ Inspection Techniques	E-1 Identify types of measurement used in manufacturing	E-2 Select proper measurement tools	E-3 Apply proper measuring techniques	E-4 Use Metric and English standards of measurement	E-5 Perform measurements with hand held instruments	E-6 Perform measurements on surface plate	E-7 Perform inspections using stationary equipment	E-8 Perform inspection using coordinate measuring equipment and techniques	E-9 Understand and use cutting and special tools (i.e., fixtures, risers, jigs, etc.)	E-10 Understand the principles of metal cutting (speeds and feeds)	E-11 Understand the principles of tool design	E-12 Understand and perform basic sheetmetal fabrication	E-13 Understand finishing processes (e.g., paint, plate, clean)
F Perform Conventional Machining Operations	F-1 Prepare and plan for machining operations	F-2 Use proper hand tools	F-3 Set up/operate power saws	F-4 Set up/operate drill presses	F-5 Set up/operate vertical milling machines	F-6 Set up/ operate horizontal milling machines	F-7 Set up/operate metal cutting lathes	F-8 Set up/ operate grinding/ abrasive machines					
G Perform Advanced Machining Processes	G-1 Prepare and plan for CNC machining operations	G-2 Select and use CNC tooling systems	G-3 Program CNC machines	G-4 Set up/ operate CNC machining centers (mills)	G-5 Set up/ operate CNC turning centers (lathes)	G-6 Set up/ operate electrical discharge machines	G-7 Download programs via network						
H Perform Welding Operations	H-1 Weld with Shielded Metal Arc Welding (SMAW) process	H-2 Weld/cut with oxyacetylene	H-3 Weld with Gas Tungsten Arc Welding (GTAW) (Heliarc)	H-4 Weld with Gas Metal Arc Welding (GMAW)/ (Mig) and Flux Core Arc Welding (FCAW)	H-5 Perform Plasma Arc Cutting (PAC)								
I Perform Drafting Tasks	I-1 Demonstrate traditional mechanical drafting skills	I-2 Use Computer-Aided Drafting (CAD) system	I-3 Create 3-D solid models	I-4 Make tool drawings									

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Duties	Tasks												
J Use Computers	J-1 Use computer operating systems	J-2 Use computer inquiry systems	J-3 Use various computer applications	J-4 Recommend and implement CIM technologies	J-5 Use computer-aided engineering system								
K Participate in Total Quality and SPC Activities	K-1 Define quality in manufacturing and explain importance	K-2 Implement concepts of quality in the workplace	K-3 Apply principles and tools of continuous quality improvement	K-4 Understand and apply SPC	K-5 Evaluate data to monitor production	K-6 Analyze customer problems and recommend solutions	K-7 Establish methods, plans and procedures to maintain quality						
L Maintain Electrical Devices	L-1 Use electrical test equipment	L-2 Apply specific terms to electrical circuits	L-3 Analyze series, parallel and complex DC/AC circuits	L-4 Check AC and DC motors	L-5 Inspect transformers and generators	L-6 Discuss sensors and feedback technology	L-7 Set up/ program PLC	L-8 Troubleshoot electrical devices					
M Maintain Hydraulics/ Pneumatic Devices	M-1 Use test equipment	M-2 Describe basic principles of hydraulic systems	M-3 Identify hydraulic fluids	M-4 Recommend power distribution and sealing devices	M-5 Recognize pumps, actuators, and hydraulic control devices	M-6 Troubleshoot hydraulic/pneumatic systems							

SKILLS AND KNOWLEDGE

Communication Skills
Use Measurement Tools
Use Inspection Devices
Mathematical Skills
Reading/Writing Skills
Knowledge of Safety Regulations
Practice Safety in the Workplace
Organizational Skills
Knowledge of Company Policies/Procedures
Mechanical Aptitude
Ability to Comprehend Written/Verbal Instructions
Basic Knowledge of Fasteners
Ability to Work as Part of a Team
Converse in the Technical Language of the Trade
Knowledge of Occupational Opportunities
Knowledge of Employee/Employer Responsibilities
Knowledge of Company Quality Assurance Activities
Practice Quality-Consciousness in Performance of the Job

TEXAS STATE TECHNICAL COLLEGE WACO
MAST PROGRAM REPRESENTATIVES

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Director

JOE PENICK
Project Coordinator

TERRY SAWMA
Research Coordinator

WALLACE FELTON
Site Coordinator

ROSE MARY TIMMONS
Senior Secretary/Statistician

Furnished By:

STEPHEN APER
Specialist, Manufacturing Engineering

VINCE GEHRIN
Specialist, Technical Training

Texas State Technical College Waco

TRAITS AND ATTITUDES

Strong Work Ethic
Interpersonal Skills
Punctuality
Dependability
Honesty
Neatness
Safety Conscientious
Motivation
Responsible
Physical Ability
Professional
Trustworthy
Customer Relations
Personal Ethics

TOOLS AND EQUIPMENT

Machinist's Tools (e.g., calipers, dial indicators magnetic tool holders, etc.)
Measuring Tools
Power Tools
Metal Lathe with Attachments
Drill Presses
Vertical Mill with Attachments
Power Saws
Power Drills
Hydraulic/Arbor Press
Heat Treatment Equipment
Hardness Testing Equipment
Grinding Machines with Attachments
Welding Equipment (SMAW, GMAW, FCAW, Plasma)
CNC Machining Center and Turning Center
Gear Producing Machines with Attachments
Jig Boring Machines
Alignment/Calibration Tools
Computer
Personal Safety Equipment
Oxyacetylene Equipment
Tool Storage Equipment
Vises
Pedestal Grinders
Optical Comparator
Coordinate Measurement Machine
Hydraulic/Pneumatic Training Equipment
Electrical Training Equipment
Safety Training Equipment

FUTURE TRENDS AND CONCERNS

Statistical Process Control
Composites
Laser Machining
Advanced Computer Applications/Networking
Robotics/Vision Systems
Environmental Concerns
Fiber Optic Controls
Automated Material Handling Equipment
Computer Integrated Manufacturing
Digital Measuring Tools
Advanced Materials/Super Plastic Forming
Computer Simulation

COMPETENCY PROFILE

Manufacturing Engineering Technician

Prepared By
M.A.S.T.
Machine Tool Advanced Skills
Technology Program
and
Consortia Partners
(V.199J40008)

Texas State Technical College Waco

MCDONNELL DOUGLAS

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MANUFACTURING ENGINEERING TECHNICIAN .... use special knowledge and skills to recommend and/or implement solutions for specific manufacturing applications.

Duties	Tasks												
A Practice Safety	A-1 Follow safety manuals and all safety regulations/ requirements	A-2 Use protective equipment	A-3 Recommend and understand safe operating procedures for hand and machine tools	A-4 Maintain a clean and safe work environment	A-5 Control fire hazards	A-6 Apply American Red Cross First Aid and CPR procedures	A-7 Follow hazardous waste management techniques	A-8 Apply ergonomic principles to the workplace	A-9 Demonstrate knowledge of state and federal EPA regulations				
B Apply Mathematical Concepts	B-1 Perform basic arithmetic functions	B-2 Interconvert fractions/ decimals	B-3 Interconvert Metric/ English measurements	B-4 Perform basic algebraic operations	B-5 Perform basic trigonometric functions	B-6 Calculate speeds and feeds for machining	B-7 Locate machining points from a datum point	B-8 Perform calculations for sine bar and sine plate	B-9 Calculate for direct, simple, and angular indexing	B-10 Perform calculations necessary for turning tapers	B-11 Use all functions on a scientific calculator	B-12 Solve engineering equations	B-13 Determine strength of materials for various applications
C Interpret Engineering Drawings and Control Documents	C-1 Review blueprint notes and dimensions	C-2 Identify basic layout of drawings	C-3 Identify basic types of drawings	C-4 List the purpose of each type of drawing	C-5 Verify drawing elements	C-6 Practice Geometric Dimensioning and Tolerancing (GD&T) methodology	C-7 Describe the relationship of engineering drawings to planning	C-8 Use standards to verify requirements	C-9 Use Automated Drawing Parts List (ADPLS)	C-10 Understand and use quality systems			
D Recognize Different Manufacturing Materials and Processes	D-1 Identify materials with desired properties	D-2 Identify materials and processes to produce a product	D-3 Describe heat treating processes	D-4 Set up heat treating operations	D-5 Test metal samples for hardness	D-6 Describe casting processes	D-7 Describe hot working processes	D-8 Describe cold working processes	D-9 Evaluate alternative manufacturing processes				
E Demonstrate Measurement/ Inspection Techniques	E-1 Identify types of measurement used in manufacturing	E-2 Select proper measurement tools	E-3 Apply proper measuring techniques	E-4 Use Metric and English standards of measurement	E-5 Perform measurements with hand held instruments	E-6 Understand measurements on surface plate	E-7 Understand inspections using stationary equipment						
F Perform Conventional Machining Operations	F-1 Prepare and plan for machining operations	F-2 Operate power saws	F-3 Operate drill presses	F-4 Operate vertical milling machines	F-5 Operate horizontal milling machines	F-6 Operate metal cutting lathes	F-7 Operate grinding/ abrasive machines						
G Perform Advanced Machining Processes	G-1 Prepare and plan for CNC machining operations	G-2 Select, recommend and use CNC tooling systems	G-3 Program CNC machines	G-4 Operate CNC machining centers (mills)	G-5 Operate CNC turning centers (lathes)	G-6 Operate electrical discharge machines	G-7 Download programs via network	G-8 Understand DNC nesting system					
H Perform Welding Operations	H-1 Weld with Shielded Metal Arc Welding (SMAW) process	H-2 Weld/cut with oxyacetylene	H-3 Weld with Gas Tungsten Arc Welding (GTAW) (Heliarc)	H-4 Weld with Gas Metal Arc Welding (GMAW)(Mig) & Flux Core Arc Welding (FCAW)	H-5 Perform Plasma Arc Cutting (PAC)	H-6 Perform electron beam welding	H-7 Understand welding inspection techniques						
I Perform Drafting Tasks	I-1 Demonstrate traditional mechanical drafting skills	I-2 Use Computer-Aided Drafting (CAD) system	I-3 Create 3-D solid models	I-4 Make tool drawings	I-5 Digitize drawings	I-6 Understand scanning processes for drawings							
J Use Computers	J-1 Use computer operating systems	J-2 Use computer inquiry systems	J-3 Use various computer applications	J-4 Recommend and implement CIM technologies	J-5 Use computer-aided engineering system								

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Duties	Tasks												
K Participate in Total Quality and SPC Activities	K-1 Define quality in manufacturing and explain importance	K-2 Implement concepts of quality in the workplace	K-3 Apply principles and tools of continuous quality improvement	K-4 Understand and apply SPC	K-5 Evaluate data to monitor production	K-6 Analyze customer problems and recommend solutions	K-7 Establish methods, plans and procedures to maintain quality	K-8 Understand variability reduction/value engineering					
L Maintain Electrical Devices	L-1 Understand electrical test equipment	L-2 Apply specific terms to electrical circuits	L-3 Analyze series, parallel and complex DC/AC circuits	L-4 Check AC and DC motors	L-5 Inspect transformers and generators	L-6 Discuss sensors and feedback technology	L-7 Set up/ program PLC	L-8 Trouble-shoot electrical devices					
M Maintain Hydraulics/ Pneumatic Devices	M-1 Use test equipment	M-2 Describe basic principles of hydraulic systems	M-3 Identify hydraulic fluids	M-4 Recommend power distribution and sealing devices	M-5 Recognize pumps, actuators, and hydraulic control devices	M-6 Trouble-shoot hydraulic/pneumatic systems							
N Production Control and Scheduling	N-1 Analyze standard tooling and work order repair schedules	N-2 Forecast work order repair times and methods	N-3 Expedite repair processes	N-4 Analyze cost/time efficiencies (make vs. buy decisions)									

SKILLS AND KNOWLEDGE

Communication Skills
Use Measurement Tools
Use Inspection Devices
Mathematical Skills
Reading/Writing Skills
Knowledge of Safety Regulations
Practice Safety in the Workplace
Organizational Skills
Knowledge of Company Policies/Procedures
Mechanical Aptitude
Ability to Comprehend Written/Verbal Instructions
Basic Knowledge of Fasteners
Ability to Work as Part of a Team
Converse in the Technical Language of the Trade
Knowledge of Occupational Opportunities
Knowledge of Employee/Employer Responsibilities
Knowledge of Company Quality Assurance Activities
Practice Quality-Consciousness in Performance of the Job

SPRINGFIELD TECHNICAL COMMUNITY COLLEGE - MAST PROGRAM REPRESENTATIVES

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Director, Center for Business & Technology

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Department Chairman
Mechanical Engineering Technology

NICK M. MASSA
Director of Technology Development

ROSE MARY TIMMONS
Senior Secretary/Technician (TSTC)

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SMITH & WESSON

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Plant Metallurgist/Materials Engineer

RONALD P. BORGIO
Director TQM/ISO Audit

JAMES PELLITIER
Manager of Product & Advanced Processing Engineering

RICHARD MARLOW
Superintendent of Services

MAURO DE MAIO, C.Q.E.
Senior Plant Engineer

BOB PION
Director, Human Resources Development

SPRINGFIELD TECHNICAL COMMUNITY COLLEGE

TRAITS AND ATTITUDES

Strong Work Ethic
Interpersonal Skills
Punctuality
Dependability
Honesty
Neatness
Safety Conscientious
Motivation
Responsible
Physical Ability
Professional
Trustworthy
Customer Relations
Personal Ethics

TOOLS AND EQUIPMENT

Machinist's Tools (e.g., calipers, dial indicators magnetic tool holders, etc.)
Measuring Tools
Power Tools
Metal Lathe with Attachments
Drill Presses
Vertical Mill with Attachments
Power Saws
Power Drills
Hydraulic/Arbor Press
Heat Treatment Equipment
Hardness Testing Equipment
Grinding Machines with Attachments
Welding Equipment (SMAW, GMAW, FCAW, Plasma)
CNC Machining Center and Turning Center
Gear Producing Machines with Attachments
Jig Boring Machines
Alignment/Calibration Tools
Coolant Recovery Equipment
Computer
Ventilation Equipment
Forklift
Personal Safety Equipment
Oxyacetylene Equipment
Tool Storage Equipment
Workbenches
Vises
Pedestal Grinders
Weld Test Equipment
Optical Comparator
Coordinate Measurement Machine
Hydraulic/Pneumatic Training Equipment
Electrical Training Equipment
Safety Training Equipment

FUTURE TRENDS AND CONCERNS

Statistical Process Control
Composites
Laser Machining
Advanced Computer Applications
Robotics
Environmental Concerns
Fiber Optic Controls
Automated Material Handling Equipment
Computer Integrated Manufacturing

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COMPETENCY PROFILE

Manufacturing Engineering Technician

Prepared By
M.A.S.T.
Machine Tool Advanced Skills Technology Program
and
Consortia Partners
(V.199J40008)

SPRINGFIELD TECHNICAL COMMUNITY COLLEGE

MANUFACTURING ENGINEERING TECHNICIAN .... use special knowledge and skills to recommend and/or implement solutions for specific manufacturing applications.

Duties	Tasks												
A Practice Safety	A-1 Follow safety manuals and all safety regulations/ requirements	A-2 Use protective equipment	A-3 Follow safe operating procedures for hand and machine tools	A-4 Maintain a clean and safe work environment	A-5 Control fire hazards	A-6 Apply American Red Cross First Aid and CPR procedures	A-7 Recommend hazardous waste management techniques	A-8 Apply ergonomic principles to the workplace	A-9 Demonstrate knowledge of state and federal EPA regulations				
B Apply Mathematical Concepts	B-1 Perform basic arithmetic functions	B-2 Interconvert fractions/ decimals	B-3 Interconvert Metric/ English measurements	B-4 Perform basic algebraic operations	B-5 Perform basic trigonometric functions	B-6 Calculate speeds and feeds for machining	B-7 Locate machining points from a datum point	B-8 Perform calculations for sine bar and sine plate	B-9 Calculate for direct, simple, and angular indexing	B-10 Perform calculations necessary for turning tapers	B-11 Solve for little "h"	B-12 Use all functions on a scientific calculator	B-13 Solve engineering equations
	B-14 Determine strength of materials for various applications												
C Perform Computer Aided Drafting (CAD)	C-1 Understand PC basics	C-2 Discuss CAD basics and file management	C-3 Use drawing settings	C-4 Perform basic editing commands	C-5 Create drawings with accuracy	C-6 Organize drawing information	C-7 Control the display of drawings	C-8 Use intermediate drawing commands	C-9 Perform intermediate editing commands	C-10 Create multiview drawings	C-11 Create sectioned drawings	C-12 Investigate basic dimensioning	C-13 Perform advanced dimensioning
	C-14 Use and manipulate blocks	C-15 Use blocks to automate the drawing process											
D Recognize Different Manufacturing Materials and Processes	D-1 Identify materials with desired properties	D-2 Describe heat treating processes	D-3 Perform heat treating operations	D-4 Test metal samples for hardness	D-5 Describe casting processes	D-6 Describe hot working processes	D-7 Describe cold working processes	D-8 Evaluate alternative manufacturing processes					
E Perform Measurement and Inspection	E-1 Study basics of metrology	E-2 Select instruments used for measurement	E-3 Interpret limits and tolerances	E-4 Select gagging tools	E-5 Use CMM for location of features	E-6 Perform surface metrology	E-7 Perform measurement by comparison	E-8 Perform circularity, cylindricity, profile of a line, and runout measurements	E-9 Investigate advanced metrology topics				
F Perform Conventional Machining Operations	F-1 Prepare and plan for machining operations	F-2 Use proper hand tools	F-3 Operate power saws	F-4 Operate drill presses	F-5 Operate vertical milling machines	F-6 Operate horizontal milling machines	F-7 Operate metal cutting lathes	F-8 Operate grinding/ abrasive machines					
G Perform CNC Programming	G-1 Apply machine specific (milling and lasers) nomenclature and terminology	G-2 Investigate the Cartesian coordinate system as applied to milling and laser machines	G-3 Apply CNC programming language	G-4 Perform start up, tool changing, and ending of programs	G-5 Perform positioning and basic drilling	G-6 Create a sub-program	G-7 Use position and fixed cycles	G-8 Perform contouring	G-9 Apply tool radius compensation (cutter comp)	G-10 Perform programming preparation	G-11 Apply special laser coding parameters		
H Perform Computer Aided Manufacturing (CAM)	H-1 Understand the basics of a PC based CAM system	H-2 Discuss basic CAM operations	H-3 Set up cutting tools	H-4 Create part profiles	H-5 Edit part profiles	H-6 Perform advanced editing of part profiles	H-7 Edit tool paths	H-8 Perform drilling and counterboring	H-9 Use construction layers in SmartCAM	H-10 Perform user commands and machine events	H-11 Create families of parts	H-12 Perform CAD/CAM integration	H-13 Perform code generation

Duties	Tasks											
I — Participate in Total Quality and SPC Activities	I-1 Define quality in manufacturing and explain importance	I-2 Implement concepts of quality in the workplace	I-3 Apply principles and tools of continuous quality improvement	I-4 Understand and apply SPC	I-5 Evaluate data to monitor production	I-6 Analyze customer problems and recommend solutions	I-7 Establish methods, plans and procedures to maintain quality					
J — Maintain Electrical Devices	J-1 Use electrical test equipment	J-2 Apply specific terms to electrical circuits	J-3 Analyze series, parallel and complex DC/AC circuits	J-4 Check AC and DC motors	J-5 Inspect transformers and generators	J-6 Discuss sensors and feedback technology	J-7 Set up/ program PLC	J-8 Trouble-shoot electrical devices				
K — Maintain Hydraulic/ Pneumatic Devices	K-1 Use test equipment	K-2 Describe basic principles of hydraulic systems	K-3 Identify hydraulic fluids	K-4 Recommend power distribution and sealing devices	K-5 Recognize pumps, actuators, and hydraulic control devices	K-6 Trouble-shoot hydraulic/pneumatic systems						
L — Study Production and Operations Management	L-1 Investigate the concepts of product design	L-2 Perform production and inventory planning and control (PPC)	L-3 Study repetitive and just-in time production scheduling and control	L-4 Study purchasing and vendor management								
M — Define and Use Automated Systems	M-1 Study manufacturing cells	M-2 Study automated material movement and storage systems	M-3 Discuss robot classification	M-4 Study end-of-arm tooling	M-5 Identify automation sensors	M-6 Perform robot programming	M-7 Use vision systems					

SKILLS AND KNOWLEDGE

Communication Skills
Use Measurement Tools
Use Inspection Devices
Mathematical Skills
Reading/Writing Skills
Knowledge of Safety Regulations
Practice Safety in the Workplace
Organizational Skills
Knowledge of Company Policies/Procedures
Mechanical Aptitude
Ability to Comprehend Written/Verbal Instructions
Basic Knowledge of Fasteners
Ability to Work as Part of a Team
Converse in the Technical Language of the Trade
Knowledge of Occupational Opportunities
Knowledge of Employee/Employer Responsibilities
Knowledge of Company Quality Assurance Activities
Practice Quality Consciousness in Performance of the Job

SPRINGFIELD TECHNICAL COMMUNITY COLLEGE MAST PROGRAM REPRESENTATIVES

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Director, Center for Business & Technology

GARY J MASCIADRELLI
Department Chairman
Mechanical Engineering Technology

NICK M. MASSA
Director of Technology Development

ROSE MARY TIMMONS
Senior Secretary/Statistician (TSTC)

Furnished By:

UNITED TECHNOLOGIES HAMILTON STANDARD

JOHN TRUSH
Manufacturing Manager

SPRINGFIELD TECHNICAL COMMUNITY COLLEGE

TRAITS AND ATTITUDES

Strong Work Ethic
Interpersonal Skills
Punctuality
Dependability
Honesty
Neatness
Safety Conscientious
Motivation
Responsible
Physical Ability
Professional
Trustworthy
Customer Relations
Personal Ethics

TOOLS AND EQUIPMENT

Machinist's Tools (e.g., calipers, dial indicators magnetic tool holders, etc.)
Measuring Tools
Power Tools
Metal Lathe with Attachments
Drill Presses
Vertical Mill with Attachments
Power Saws
Power Drills
Hydraulic/Arbor Press
Heat Treatment Equipment
Hardness Testing Equipment
Grinding Machines with Attachments
Welding Equipment (SMAW, GMAW, FCAW, Plasma)
CNC Machining Center and Turning Center
Gear Producing Machines with Attachments
Jig Boring Machines
Alignment/Calibration Tools
Coolant Recovery Equipment
Computer
Ventilation Equipment
Forklift
Personal Safety Equipment
Oxyacetylene Equipment
Tool Storage Equipment
Workbenches
Vises
Pedestal Grinders
Weld Test Equipment
Optical Comparator
Coordinate Measurement Machine
Hydraulic/Pneumatic Training Equipment
Electrical Training Equipment
Safety Training Equipment

FUTURE TRENDS AND CONCERNS

Statistical Process Control
Composites
Laser Machining
Advanced Computer Applications
Robotics
Environmental Concerns
Fiber Optic Controls
Automated Material Handling Equipment
Computer Integrated Manufacturing

COMPETENCY PROFILE

Manufacturing Engineering Technician

Prepared By
M.A.S.T.
Machine Tool Advanced Skills Technology Program
and
Consortia Partners
(V.199J40008)

SPRINGFIELD TECHNICAL COMMUNITY COLLEGE

UNITED TECHNOLOGIES HAMILTON STANDARD

MANUFACTURING ENGINEERING TECHNICIAN .... use special knowledge and skills to recommend and/or implement solutions for specific manufacturing applications.

Duties	Tasks												
A Practice Safety	A-1 Follow safety manuals and all safety regulations/ requirements	A-2 Use protective equipment	A-3 Follow safe operating procedures for hand and machine tools	A-4 Maintain a clean and safe work environment	A-5 Control fire hazards	A-6 Apply American Red Cross First Aid and CPR procedures	A-7 Recommend hazardous waste management techniques	A-8 Apply ergonomic principles to the workplace	A-9 Demonstrate knowledge of state and federal EPA regulations				
B Apply Mathematical Concepts	B-1 Perform basic arithmetic functions	B-2 Interconvert fractions/ decimals	B-3 Interconvert Metric/ English measurements	B-4 Perform basic algebraic operations	B-5 Perform basic trigonometric functions	B-6 Calculate speeds and feeds for machining	B-7 Locate machining points from a datum point	B-8 Perform calculations for saw bar and saw plate	B-9 Calculate for direct, simple, and angular indexing	B-10 Perform calculations necessary for turning tapers	B-11 Solve for little "h"	B-12 Use all functions on a scientific calculator	B-13 Solve engineering equations
	B-14 Solve static systems for resultant force	B-15 Determine strength of materials for various applications											
C Perform Computer Aided Drafting (CAD)	C-1 Understand PC basics	C-2 Discuss CAD basics and file management	C-3 Use drawing settings	C-4 Perform basic editing commands	C-5 Create drawings with accuracy	C-6 Organize drawing information	C-7 Control the display of drawings	C-8 Use intermediate drawing commands	C-9 Perform intermediate editing commands	C-10 Create multiview drawings	C-11 Create sectioned drawings	C-12 Investigate basic dimensioning	C-13 Perform advanced dimensioning
	C-14 Use and manipulate blocks	C-15 Use blocks to automate the drawing process											
D Recognize Different Manufacturing Materials and Processes	D-1 Identify materials with desired properties	D-2 Describe heat treating processes	D-3 Perform heat treating operations	D-4 Test metal samples for hardness	D-5 Describe casting processes	D-6 Describe hot working processes	D-7 Describe cold working processes	D-8 Evaluate alternative manufacturing processes					
E Perform Measurement and Inspection	E-1 Study basics of metrology	E-2 Select instruments used for measurement	E-3 Interpret limits and tolerances	E-4 Select gagging tools	E-5 Use CMM for location of features	E-6 Perform surface metrology	E-7 Perform measurement by comparison	E-8 Perform circularity, cylindricity, profile of a line, and runout measurements	E-9 Investigate advanced metrology topics				
F Perform Conventional Machining Operations	F-1 Prepare and plan for machining operations	F-2 Use proper hand tools	F-3 Operate power saws	F-4 Operate drill presses	F-5 Operate vertical milling machines	F-6 Operate horizontal milling machines	F-7 Operate metal cutting lathes	F-8 Operate grinding/ abrasive machines					
G Perform CNC Programming	G-1 Apply machine specific (milling and lasers) nomenclature and terminology	G-2 Investigate the Cartesian coordinate system as applied to milling and laser machines	G-3 Apply CNC programming language	G-4 Perform start up, tool changing, and ending of programs	G-5 Perform positioning and basic drilling	G-6 Create a sub-program	G-7 Use position and fixed cycles	G-8 Perform contouring	G-9 Apply tool radius compensation (cutter comp)	G-10 Perform programming preparation	G-11 Apply special laser coding parameters		
H Perform Computer Aided Manufacturing (CAM)	H-1 Understand the basics of a PC based CAM system	H-2 Discuss basic CAM operations	H-3 Set up cutting tools	H-4 Create part profiles	H-5 Edit part profiles	H-6 Perform advanced editing of part profiles	H-7 Edit tool paths	H-8 Perform drilling and counterboring	H-9 Use construction layers in SmartCAM	H-10 Perform user commands and machine events	H-11 Create families of parts	H-12 Perform CAD/CAM integration	H-13 Perform code generation

Duties	Tasks												
I Participate in Total Quality and SPC Activities	I-1 Define quality in manufacturing and explain importance	I-2 Implement concepts of quality in the workplace	I-3 Apply principles and tools of continuous quality improvement	I-4 Understand and apply SPC	I-5 Evaluate data to monitor production	I-6 Analyze customer problems and recommend solutions	I-7 Establish methods, plans and procedures to maintain quality						
J Maintain Electrical Devices	J-1 Use electrical test equipment	J-2 Apply specific terms to electrical circuits	J-3 Analyze series, parallel and complex DC/AC circuits	J-4 Check AC and DC motors	J-5 Inspect transformers and generators	J-6 Discuss sensors and feedback technology	J-7 Set up/ program PLC	J-8 Trouble-shoot electrical devices					
K Maintain Hydraulic/ Pneumatic Devices	K-1 Use test equipment	K-2 Describe basic principles of hydraulic systems	K-3 Identify hydraulic fluids	K-4 Recommend power distribution and sealing devices	K-5 Recognize pumps, actuators, and hydraulic control devices	K-6 Trouble-shoot hydraulic/pneumatic systems							
L Study Production and Operations Management	L-1 Investigate the concepts of product design	L-2 Perform production and inventory planning and control (PIPC)	L-3 Perform forecasting demand for finished products and services	L-4 Perform capacity requirements planning and master production scheduling	L-5 Perform Materials Requirement Planning (MRP I) and Manufacturing Resource Planning (MRP II)	L-6 Study re-order point and re-order quantity methods	L-7 Study low-volume job shop scheduling and control	L-8 Study repetitive and just-in time production scheduling and control	L-9 Study purchasing and vendor management	L-10 Design production and service facility			
M Define and Use Automated Systems	M-1 Study manufacturing cells	M-2 Describe group technology	M-3 Study automated material movement and storage systems	M-4 Discuss robot classification	M-5 Study end-of-arm tooling	M-6 Identify automation sensors	M-7 Implement computer integrated manufacturing with robots	M-8 Perform robot programming	M-9 Use vision systems				

For more information:

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Waco, TX 76705

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